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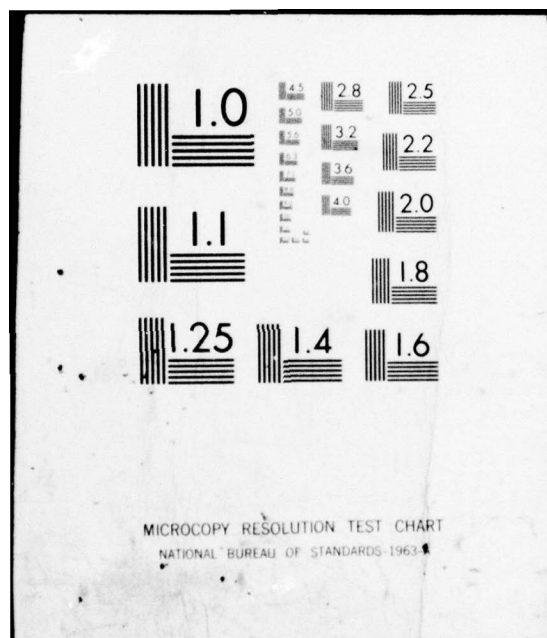
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THESIS

A STUDY OF SPECTRUM LOADING AND  
RANGE-PAIR COUNTING METHOD EFFECTS  
ON CUMULATIVE FATIGUE DAMAGE

by

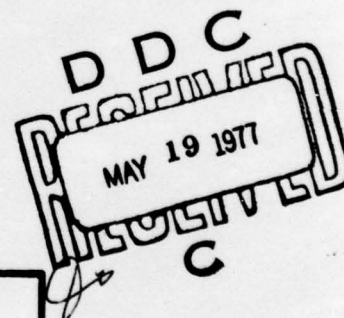
John Scott Atkinson, Jr.

March 1977

Thesis Advisor:

G. H. Lindsey

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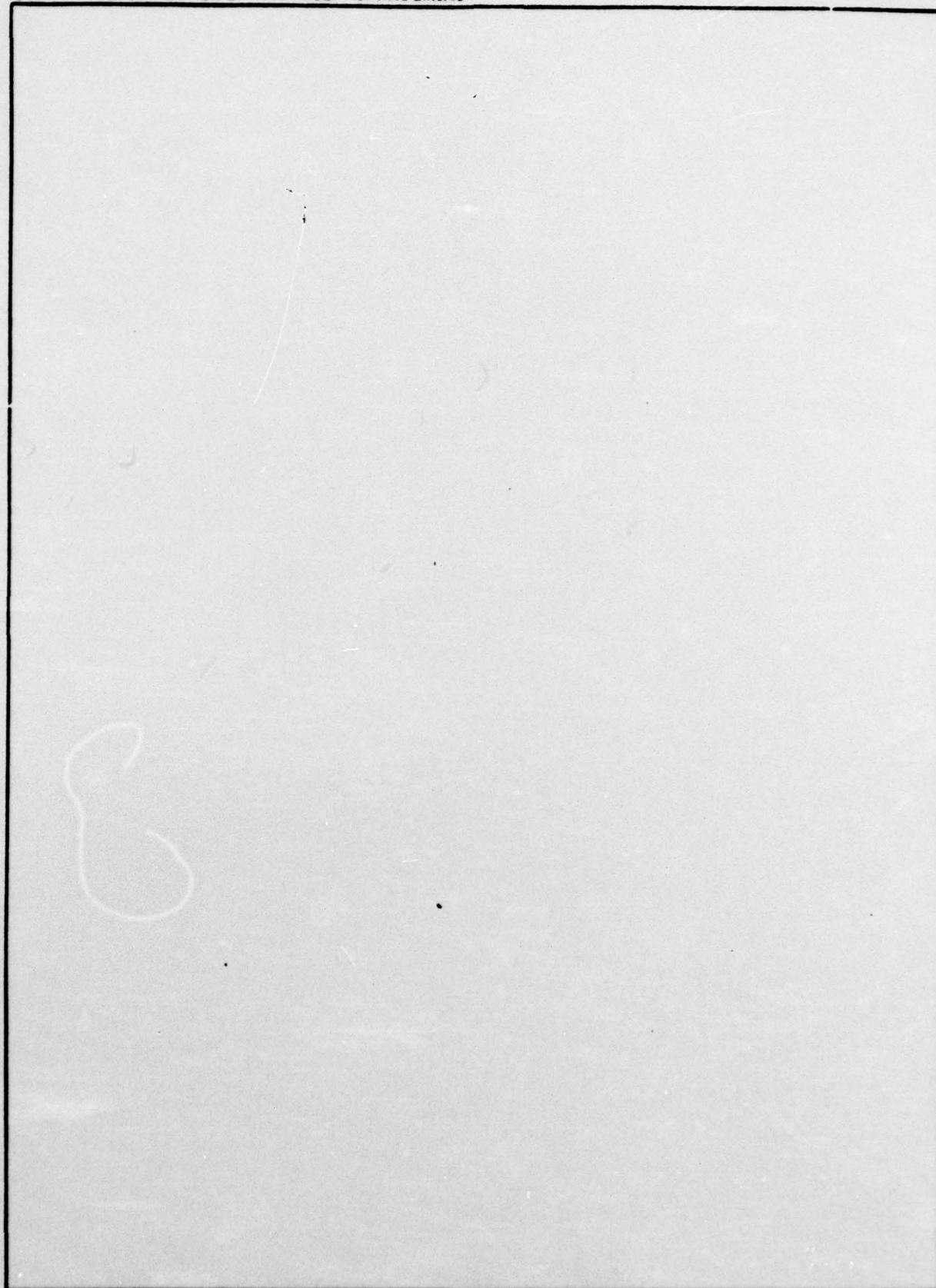
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A Study of Spectrum Loading and  
Range-Pair Counting Method Effects  
on Cumulative Fatigue Damage

by

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Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN AERONAUTICAL ENGINEERING

from the

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### ABSTRACT

This thesis is a study of cumulative fatigue damage. Variations in cumulative fatigue damage resulting from block loading spectra and randomized cycle loading spectra are investigated. Fatigue damage results show the merit of counting load cycles using the range-pair counting method. Complete FORTRAN computer program documentation enables this thesis to serve as a program user's manual.

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## LIST OF SYMBOLS

A	Coefficient of the $x^2$ term in the equation of a line on a constant life fatigue diagram where minimum stress is $x$ and maximum stress is $y$ . ( $R = Ax^2 + Bx + C - y$ )
AA	An assigned value of +1. or -1.
AAA	A stress used in the calculation of plastic strain.
ABDIF	The absolute value of DIF.
ABM	The absolute value of ASMAX or of ASMIN, as assigned.
ABMAX	The absolute value of ASMAX.
ABMEAN	The absolute value of ASMEAN
ABMIN	The absolute value of ASMIN.
ABR4	The absolute value of R(4).
ABR7	The absolute value of R(7).
ABS	The name of a routine calling for the absolute value of a quantity.
AKT	Stress concentration factor, $K_t$ .
ASMAX	The product (AKT)(STMAX).
ASMEAN	The quantity (ASMAX + ASMIN)/2.
ASMIN	The product (AKT)(STMIN).
AVSGMN	Average value of SIGMIN over an interval.
AVSGMX	Average value of SIGMAX over an interval.
B	Coefficient of the $x$ term. (see A)
BBB	A stress used in the calculation of plastic strain.
C	The constant. (see A)
COFMAN	Inverse of the Coffin-Manson slope.
CYCINT	The number of cycles in an interval.

CYCLES The calculated number of cycles expected to be indicated on a constant life fatigue diagram for the applied combination of maximum and minimum stress.

C1 The Residual Stress Relaxation Constant. (see ENEP)

DAM Damage.

DECK Decimal or real value of integer K after conversion.

DEL2 A portion of a least-squares-method solution.

DIF The difference between residual stress and equilibrium residual stress. (RES(I) - EQRES)

DO2 A portion of a least-squares-method solution.

DUMMY A variable used in the calculation of the number of cycles to be considered as an interval for relaxation determination.

ELMOD The elastic modulus.

EN The number of cycles from the beginning of the relaxation process to the end of the current interval.

ENEP The number of cycles required for overload residual stress effect to return to within one-tenth of its original difference from equilibrium conditions.

$$(N_{ep} = C1/(ABM)^{E1} (ABMEAN)^{E2})$$

ENN The number of applied cycles at a load level.

ENNCYC The ratio of the number of applied cycles to the number of cycles to failure. (ENN/CYCLES)

EPSD LCF strain intercept.

EQRES Equilibrium residual stress.

EX An exponential function depicting the relaxation of residual stress.

EXP The name of a routine calling for the exponential value of a quantity.

EXPO An exponent. The power of 10 which indicates the number of cycles to failure.

E1 Residual stress relaxation exponent.

E2 Residual stress relaxation exponent.

FLOAT	The name of a routine calling for integer-to-real conversion.
I	A variable subscript.
IBLOCK	The identifying number of a block, the blocks being numbered consecutively from 1 to NBLOCK.
IFIX	The name of a routine calling for real-to-integer conversion.
IN	The number of steps input to the range-pair counting subroutine.
IPRINT	Value controlling the WRITE statements.
IRAIN	A counter.
IRPCM	Value controlling entry into the range-pair counting subroutine.
ISTEP	The identifying step number, the steps being numbered from 1 to NLEVEL.
ITYPE	The identifying type number, the types being numbered from 1 to NTYPE.
J	A variable subscript.
JA	Value of +1 or 0, as assigned for branch determination.
JB	Value of -1 or 0, as assigned for branch determination.
JJ	An index variable.
JJJ	An index variable.
JKL	An index variable.
K	An index variable.
KK	An index variable.
KPMAX	The number of steps output from the range-pair counting subroutine.
L	An index variable.
LMN	An index variable.
M	An index variable.
N	An index variable with values of N=4-7 indicating the power of 10, and thus identifying a particular life cycle curve.



NBLOCK The total number of times to execute a block of loads.  
 NDECK The number of data decks to be run sequentially.  
 NFLAG An integer used as a counter.  
 NFLAG2 An integer used as a counter.  
 NLEVEL The total number of steps, or levels, of loads in a block.  
 NN A subscripted variable used to indicate which types of loads are experienced in which blocks.  
 NTYPE The total number of different types.  
 PLSTRA Plastic strain.  
 R Residue term in damage calculation.  
 RES Residual stress.  
 RNCYC The number of cycles for a level after exiting the range-pair counting subroutine.  
 SIGMAX Maximum stress.  
 SIGMIN Minimum stress.  
 STMAX Maximum applied stress.  
 STMIN Minimum applied stress.  
 SUMDEL Summation of damage for a flight.  
 SUMENN Accumulated total of applied cycles. (Summation of ENN)  
 SUMNC Accumulated cycle ratio. (Summation of ENN/CYCLES)  
 SUMR Summation of  $R(N)$ ,  $N=4,7$ .  
 SUMRN Summation of  $NR(N)$ ,  $N=4,7$ .  
 SUMR2 Summation of  $R(N)^2$ ,  $N=4,7$ .  
 SUMR2N Summation of  $NR(N)^2$ ,  $N=4,7$ .  
 SUMR3 Summation of  $R(N)^3$ ,  $N=4,7$ .  
 SUMR4 Summation of  $R(N)^4$ ,  $N=4,7$ .  
 TITLE1 Identification of the source of the S-N data.

TLL      Tensile limit load.  
TM1,TM2   Material type.  
TTY5      One-fifth of tensile yield stress.  
TYS      Tensile yield stress.  
T1,T2      Test identifying information.  
X          Variable equivalent to SIGMIN.  
Y          Variable equivalent to SIGMAX.

## I. INTRODUCTION

In an aircraft fatigue life monitoring program, determination of the actual loading environment which produces the fatigue is a major problem. With both military trainer and fighter aircraft, which may be used for a variety of duties, regular or continuous load recording programs have to be considered mandatory. Such load recording programs provide the data to calculate the consumed fatigue life of operating aircraft and are used in selecting design spectra for future aircraft designs.

To facilitate the calculations of fatigue life from such data, it is important to know not only the loading magnitudes but also the time sequence of the loading. The fatigue life of a local critical point varies due to residual stresses remaining after the application of a load causing local plasticity in tension or compression. For instance, a peak tensile load into the plastic flow region leaves a residual compressive stress, which lowers the local magnitude of the following tensile stresses, thus increasing the fatigue life. In a similar manner a peak compressive load into the plastic flow region, if it were to occur, would leave a residual tensile stress, which decreases the fatigue life.

Currently, fatigue monitoring of naval aircraft is based on the total number of g readings recorded at four



selected levels by an exceedence level counting accelerometer. Using microprocessors in the near future it will be possible to record each maximum and minimum load level experienced by an aircraft in sequence. The data collected can be used to monitor the fatigue life of a structure via the determination of damage accumulated at a point found to be critical in a structural test of a prototype. It should be noted that this calculation uses a theoretical model. Damage is not observable or measurable.

The objective of this thesis is to use a computer program, employing the range-pair counting technique on time sequence recorded maximum and minimum aircraft loads and a relaxation model to consider residual stresses, to calculate plastic, elastic, and total aircraft structural damage.

## II. GENERAL DESCRIPTION OF THE COMPUTER PROGRAM

The computer program used in this fatigue analysis is divided into four modules. Each module is clearly labeled in the program listing (page 93). In module I the input data are read and assimilated in preparation for future calculations. The input parameter requirements are presented in detail beginning on page 18, and six sample sets of input data are illustrated starting on page 40.

When the load sequence randomization technique is used to input loading data, it is a part of module I. The load sequence randomization technique uses the computer library subroutine RANDU to place 10 percent of the MIL spectrum A positive loads (Table I) in a random order. Each of the positive loads is paired with a minimum load of 11 percent limit load, or 1-g. During the randomization each load has an equal probability of selection. A counter restricts the number of times a value is selected to the number of occurrences of the particular load level in MIL spectrum A.

Two variations on the randomization of the MIL spectrum A load levels are available. The first option permits randomization of the negative MIL spectrum A load levels using the same technique as in the case of the positive MIL spectrum A load levels. Each negative load level is randomly paired with a positive load level. Since there are not as many negative load levels in MIL spectrum A as



TABLE I

FREQUENCY OF MANEUVER LOADS

NUMBER OF TIMES PER THOUSAND HOURS THAT  
LOAD FACTOR IS EXPERIENCED

PERCENT OF MAXIMUM (POSITIVE)  
SYMMETRICAL LIMIT LOAD FACTOR

FLIGHT MANEUVER LOAD  
SPECTRUM A

35	17000
45	9500
55	6500
65	4500
75	2500
85	1360
95	440
105	150
115	40
125	16
TOTAL	42006

PERCENT OF MAXIMUM (NEGATIVE)  
SYMMETRICAL LIMIT LOAD FACTOR

FLIGHT MANEUVER LOAD  
SPECTRUM A

0	500
10	200
20	100
30	60
40	35
50	30
60	25
70	20
80	15
90	10
100	5
110	3
TOTAL	1003

there are positive load levels, the excess load levels are paired with 1-g loads. Mixing of the negative MIL spectrum A load levels and the 1-g load levels is accomplished using the computer library subroutine RANDU. For this ordering there is an 80 percent chance that each negative load selected will be a 1-g load. A counter ensures the proper numbers of each load type are included. Eighty percent probability of selection of a 1-g load was used to spread the smaller number of negative MIL spectrum A loads throughout the sequence, and also to speed computer operation by not having the matrix of negative MIL spectrum A loads addressed so often, after the counter indicated the matrix elements had all been used.

The second option for randomizing loads provides for the inclusion of a ground cycle between each flight. The ground cycle loading is taken as -2500 psi, or -8 percent limit load. Eight percent is the level of the ground cycle load used by the A7 manufacturer. There are 4201 positive loading events in 100 hours of MIL spectrum A flight time. Each flight is arbitrarily taken as one hour in length, so a ground load is paired with every forty-second positive loading event.

In module II the local stresses and strains are determined from the input data. If the local peak stress is in the plastic region, the specimen is assumed to unload elastically, leaving a local residual compressive stress in the material. In the analysis developed by Potter [Ref. 6],

the transient portion of the residual stress so produced relaxes toward zero, or an equilibrium residual stress. After the stresses and strains are calculated, the local stress cycles are counted in module III using the range-pair counting technique. In module IV the fatigue damage is calculated. Damage is determined separately for elastic and plastic strain events. The elastic and plastic damage for each flight is listed as output, as well as the total cumulative damage from any previous flights.

#### A. INPUT DATA REQUIREMENTS (MODULE I)

Samples of data are listed starting on page 40; formatting is described beginning on page 93. Both pages should be consulted while reading the following descriptions.

##### 1. Data Card 1

Only one of these cards is required or permitted for each program run.

NDECK = the number of data decks to be run sequentially. The input on this card will be common to all data decks run. It is not necessary for the different data decks to have any parameters in common.

IPRINT = the value controlling the write statements. Output available during the process of the analysis includes:

a. Maximum and minimum applied stress of each cycle and the local stress response throughout the spectrum. Also printed out is the residual stress, equilibrium stress, applied cycles, and the equilibrium period for each cycle.



b. The elastic local stress history as input into the range-pair subroutine and the resulting range-paired spectrum.

c. The maximum plastic strain occurrence during the spectrum and the damage associated with each strain reversal.

d. The accumulated damage associated with the plastic strains.

e. The range-paired elastic stress spectrum and the damage associated with each level for block loading, or for each cycle for RANDU generated loadings.

f. The accumulated damage associated with the current block of loading, including the plastic strain damage, and the total damage since the initiation of cycling.

The value assigned to IPRINT controls which pieces of data are included in the printout.

If IPRINT = 1, all six items listed above are printed for each flight or block of loads.

If IPRINT = 2, all items listed above except b, are printed.

If IPRINT = 3, only items d and f listed above are printed.

An example of each output option is given beginning on page . When the number of loads is more than fifty, the output is quite voluminous, and a paper usage default may interrupt program operation. With large numbers of loads, IPRINT should be set equal to 3.

IRPCM = the value controlling entry into the range-pair counting subroutine.

If IRPCM = 1, the range-pair counting method is used.

If IRPCM = 2, the range-pair counting method is skipped.

Each data deck run sequentially must contain the following cards. The number of data decks was indicated by the value assigned NDECK.

2. Card 1

Information on this card is descriptive, alphanumeric data used only as a heading test identification.

3. Card 2

The name of the material type and four material constants are listed on this card. The material type is an alphanumeric entry. The tensile yield stress, LCF strain intercept, inverse of the Coffin-Manson slope, and the modulus of elasticity are real number entries. The LCF strain intercept is the numerical value of the ordinate intercept in the log-log Coffin-Manson plot of plastic strain range vs. cycles to failure. Units of tensile yield stress and modulus of elasticity are ksi.

4. Cards 3 Through 6

Each card contains the three coefficients of a second order least-squares curve fit for S-N data obtained from a Goodman diagram published in MIL-HDBK-5A. The curves are fit for lives of  $10^4$ ,  $10^5$ ,  $10^6$ , and  $10^7$  cycles. Space is provided on each card for an alphanumeric indication of

the data source. Only the data source printed on card 6 will be retained in computer storage for subsequent printout. Columns 72 through 80 are used for information only and are not read by the computer.

5. Card 7

Constants to be used in the equilibrium period calculations are listed on this card.

6. Card 8

The stress concentration factor is the only entry on this card.

7. Card 9

The first entry on this card is the number of blocks of loads, or the number of flights. The terms block and flight are used interchangeably. This entry is the number of times the list of loads is to be repeated. The next entry is the number of loads. The number of loads will always be the same as the quantity of cards 11 used as input. The last entry is the number of types of loads. Loads are indicated as being a different type in order to alter the loading pattern during subsequent flights. It is important to understand that the program will always consider load types in ascending numerical order. A flight listing load types in the order 1, 2, 3, 4 will produce identical results with a flight listing load types in the order, 4, 3, 2, 1.

8. Card 10

Only the limit load is listed here, with units of ksi. The maxima and minima of all cycles are input as a decimal fraction of this load entry.



#### 9. Cards 11

Information identifying each load cycle is presented on these cards. The first entry is an integer representing the step, or number of the load. This integer increments by one on each card, with the last card having a value equal to NLEVEL. Other entries on these cards are the type of load, the minimum and maximum decimal fraction of the limit load for the particular step, and the number of consecutive cycles at this load level. It is important to notice that the format requires the number of cycles to be entered as a real number, although fractions of cycles will not be processed.

#### 10. Cards NLEVEL + 11

The first entry is an integer representing the number of the block, or flight. This entry is a dummy variable and is not used in any subsequent calculations. The other entries on this card indicate which types of loads are to be processed on this particular flight. Each type of load may be processed only once on each flight. The order in which the types are listed is of no significance, since the load-types are automatically processed in ascending numerical order.

#### B. RANGE-PAIR COUNTING METHOD

In assessing the life consumed by an individual aircraft, damage is calculated from Miner's Law using S-N data. This type of life calculation is of greater value if the cycle counting method used takes into account the actual load-time

history of the aircraft. Many load cycle counting methods have been developed and used. Fatigue test experience indicates that a useful counting technique for aircraft fatigue must take into account the loading sequence as well as the magnitude of the maximum and minimum load peaks [Ref. 10]. The two most realistic counting techniques are the range-pair counting method and the rain-flow counting method. Both methods experimentally yield approximately the same results. The major difference between the two methods is that the rain-flow method counts in terms of load ranges, or half cycles, whereas the range-pair method records the time history in terms of complete load cycles. When counting in terms of full cycles, the two methods are equivalent. The merit of counting half cycles is not important when analyzing aircraft fatigue because the large number of load reversals does not permit a half cycle to influence the numerical results. The range-pair counting method corresponds to the stable cyclic stress-strain behavior of a material in that strain ranges counted as cycles will form closed stress-strain hysteresis loops [Ref. 4].

The computer program employed in this thesis has the option of using the range-pair counting method, or simply using each peak in the order that it occurs. When the range-pair counting method is not used, only momentary load values are considered, and information regarding the cyclic stress-strain pattern, which is important in fatigue calculations, is lost. Also, minor load variations, which are of little



importance in fatigue calculations, are counted as additional cycles.

The range-pair counting method is illustrated in Figure 1. It counts a strain range as a cycle if it can be paired with a subsequent straining of equal magnitude in the opposite direction. For a complicated load history, some of the ranges counted as cycles will be simple ranges, such as 2-3, during which the strain does not change direction, but others, such as 1-8, will be interrupted by smaller ranges which will also be counted as cycles. In Figure 1 ranges are marked with solid lines and the paired ranges with dashed lines.

Each peak is taken in order as the initial peak of a range, except that a peak is skipped if the part of the history immediately following it has already been paired with a previously counted range. If the initial peak of a range is a minimum, a cycle is counted between this minimum and the most positive maximum which occurs before the strain becomes more negative than the initial peak of the range. For example, in Figure 1 a cycle is counted between peak 1 and peak 8, peak 8 being the most positive maximum that occurs before the strain becomes more negative than peak 1. If the initial peak of a range is a maximum, a cycle is counted between this maximum and the most negative minimum which occurs before the strain becomes more positive than the initial peak of the range. For example, in Figure 1 a cycle is counted between peak 2 and peak 3, peak 3 being the most negative minimum before the strain becomes more

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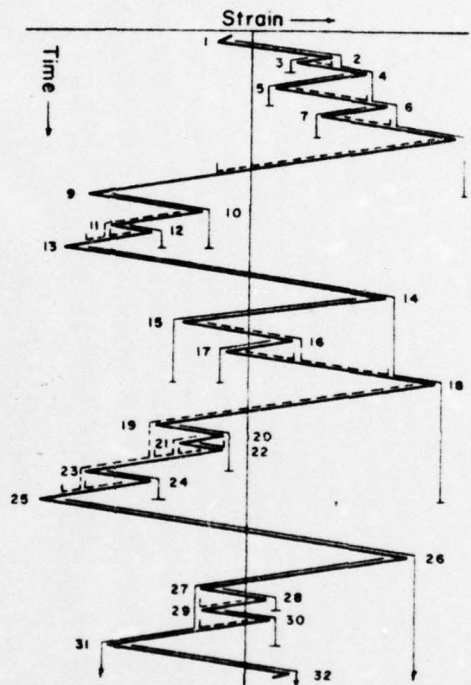


Figure 1  
Illustration of Range-Pair Counting Method

positive than peak 2. Each range that is counted is paired with the next straining of equal magnitude in the opposite direction, explaining why complete cycle rather than half cycle counts are made. For example, in Figure 1 part of the range between peaks 8 and 9 is paired with the range counted between peaks 1 and 8.

### C. DAMAGE CALCULATION

Damage due to plastic strain and damage due to elastic strain is calculated separately. The behavior of the specimen is assumed to be elastic-perfectly plastic as illustrated in Figure 2. Behavior in compression is assumed to be the same as the behavior in tension. The total damage is determined using the Miner's summation  $D = \sum n/N$  where

$D$  = total damage

$n$  = number of cycles at a particular load level

$N$  = number of cycles to failure at a particular load level

Failure of the specimen is defined as occurring when  $D$  equals unity.

Plastic strain damage is calculated using the Coffin-Manson theory [Ref. 5]. The Coffin-Manson theory is based on an experimentally determined log-log plot of plastic strain range vs. cycles to failure as shown in Figure 3. The slope of the line in Figure 3 is approximately  $-1/2$  for all metals, with the ordinate intercept making the behavior of each metal unique. The equation used for calculation of plastic strain damage is



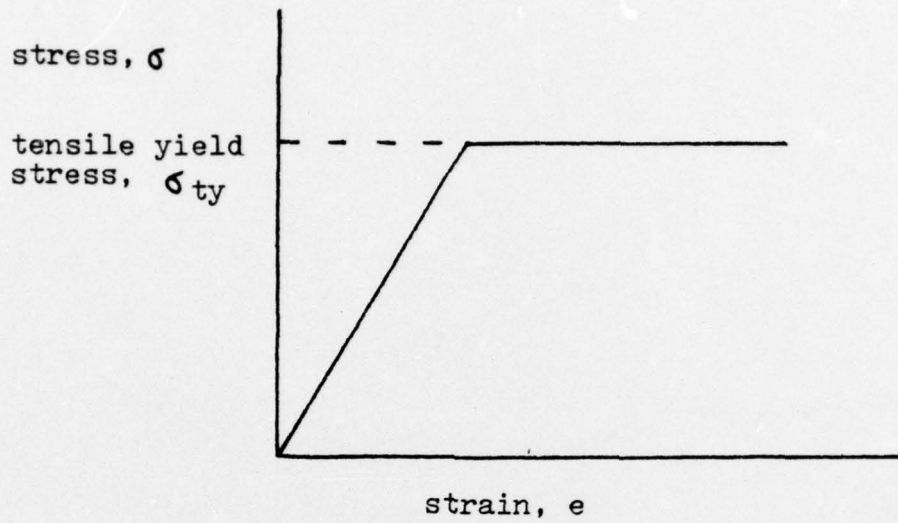


Figure 2. ELASTIC-PERFECTLY PLASTIC BEHAVIOR

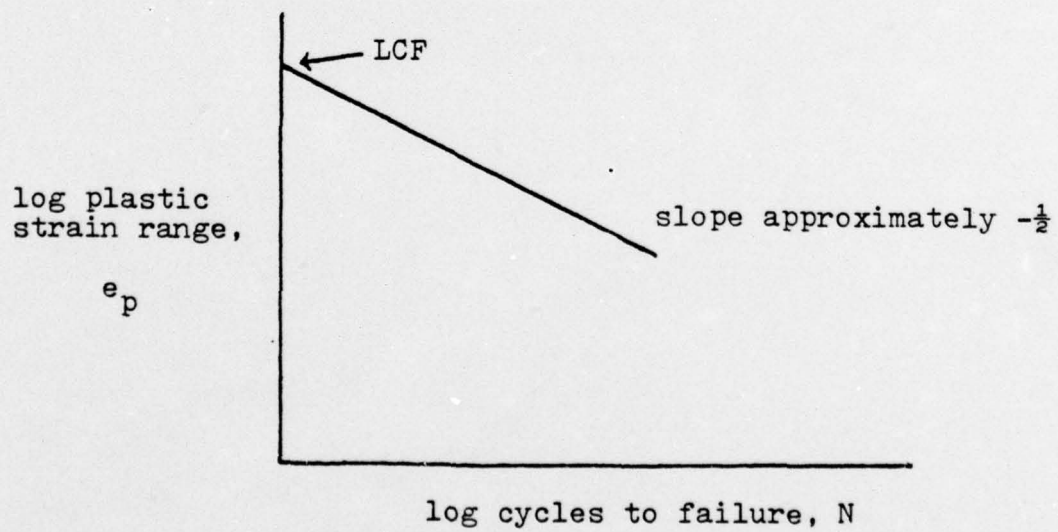


Figure 3. COFFIN-MANSON DIAGRAM

$$N = ( e_p / c ) k^{-1}$$

where  $N$  = number of cycles to failure at a specific plastic strain

$e_p$  = magnitude of the plastic strain

$k$  = slope of the Coffin-Manson curve, approximately  $- 1/2$

$c$  = ordinate intercept; experimentally for each metal type

For strain levels in the plastic range, failure occurs in less than  $10^4$  cycles, and damage is calculated using the Coffin-Manson theory. For strain levels in the elastic range, the Goodman diagram is the basis for calculation of damage. The maximum and minimum local strain levels are sequentially compared with second order least-squares curve fit data from the Goodman diagram. The curve fits used are for lives of  $10^4$ ,  $10^5$ ,  $10^6$ , and  $10^7$  cycles [Ref. 3]. The elastic damage is totaled using the Miner summation and combined with the plastic damage, computed in a similar way, to yield the total damage. The amount of plastic damage and the total damage for a particular flight, and the total damage including all previous flights is printed at the end of each flight.

### III. DISCUSSION OF RESULTS

The load spectrum used in this analysis is the load spectrum A from MIL-HDBK-5A, and the loads are assumed to be applied at wing station 32 on an A7 aircraft wing [Ref. 2]. Load data were input as block loads and also as single randomized cycles. The Miner's Law summation of fatigue damage for this loading spectrum is .1300 per 1000 flight hours. Results obtained using this computer program are given in Tables II, III, and IV. It is important to notice that when fatigue damage is calculated without using the range-pair counting method, it makes only a minor difference on the total fatigue damage when the sequence of loading is changed or when negative loads are included.

Block loads were arranged in LO-HI, HI-LO, and HI-LO-HI sequences. The results indicate the LO-HI sequence to be more damaging than the HI-LO sequence, with damage due to the HI-LO-HI sequence falling between the other two block load sequences. In the HI-LO sequence the HI loads leave a local residual compressive stress in the material, and the LO loads do less damage.

In the case of RANDU generated load sequences, identical starter integers were used in order to evaluate the effect on the damage of inclusion of MIL spectrum A negative loads and ground cycles. The more negative loads that are included, the worse is the fatigue damage. The increase in damage with more negative loads is caused by the negative loads decreasing



TABLE II

FATIGUE DAMAGE DUE TO POSITIVE MILSPEC A  
BLOCK LOADING, NORMALIZED TO 1000 HOURS

<u>SEQUENCE OF BLOCK LOADS</u>	<u>USING RPCM*</u>	<u>NOT USING RPCM*</u>
LO-HI	.16780102	.16780108
HI-LO	.069243014	.069243014
HI-LO-HI	.10864216	.10839599

\* RANGE-PAIR COUNTING METHOD

TABLE III

FATIGUE DAMAGE DUE TO MILSPEC A  
RANDOMIZED LOAD INPUTS, USING RPCM, NORMALIZED TO 1000 HOURS

<u>INTEGERS USED TO START RANDU</u>	<u>MINIMUM LOAD VALUES</u>		
	<u>11 PERCENT LIMIT LOAD</u>	<u>NEGATIVE MILSPEC A</u>	<u>GROUND CYCLES</u>
83745,54711,54487	.039226338	.046267733	.060848035
13547,66549,7	.095124505	.085063167	.10429338
9,583,4777	.043321513	.043640956	.036781987
48621,3,491	.018672124	.034077277	.035881512
73,559,1001	.031819174	.042006299	.037130679
357,833,1	.037665060	.049336702	.050973855

TABLE IV

FATIGUE DAMAGE DUE TO MILSPEC A RANDOMIZED LOAD  
INPUTS, NOT USING RPCM, NORMALIZED TO 1000 HOURS

<u>INTEGERS USED TO START RANDU</u>	<u>MINIMUM LOAD VALUES</u>		
	<u>11 PERCENT LIMIT LOAD</u>	<u>NEGATIVE MILSPEC A</u>	<u>GROUND CYCLES</u>
83745,54711,54487	.040602274	.047398917	.049124956
13547,66549,7	.040137805	.047727041	.049612150
9,583,4777	.041204430	.048346408	.049540661
48621,3,491	.041160211	.049230121	.050957575
73,559,1001	.040792227	.047043338	.049311966
357,833,1	.041056350	.049220584	.050481893

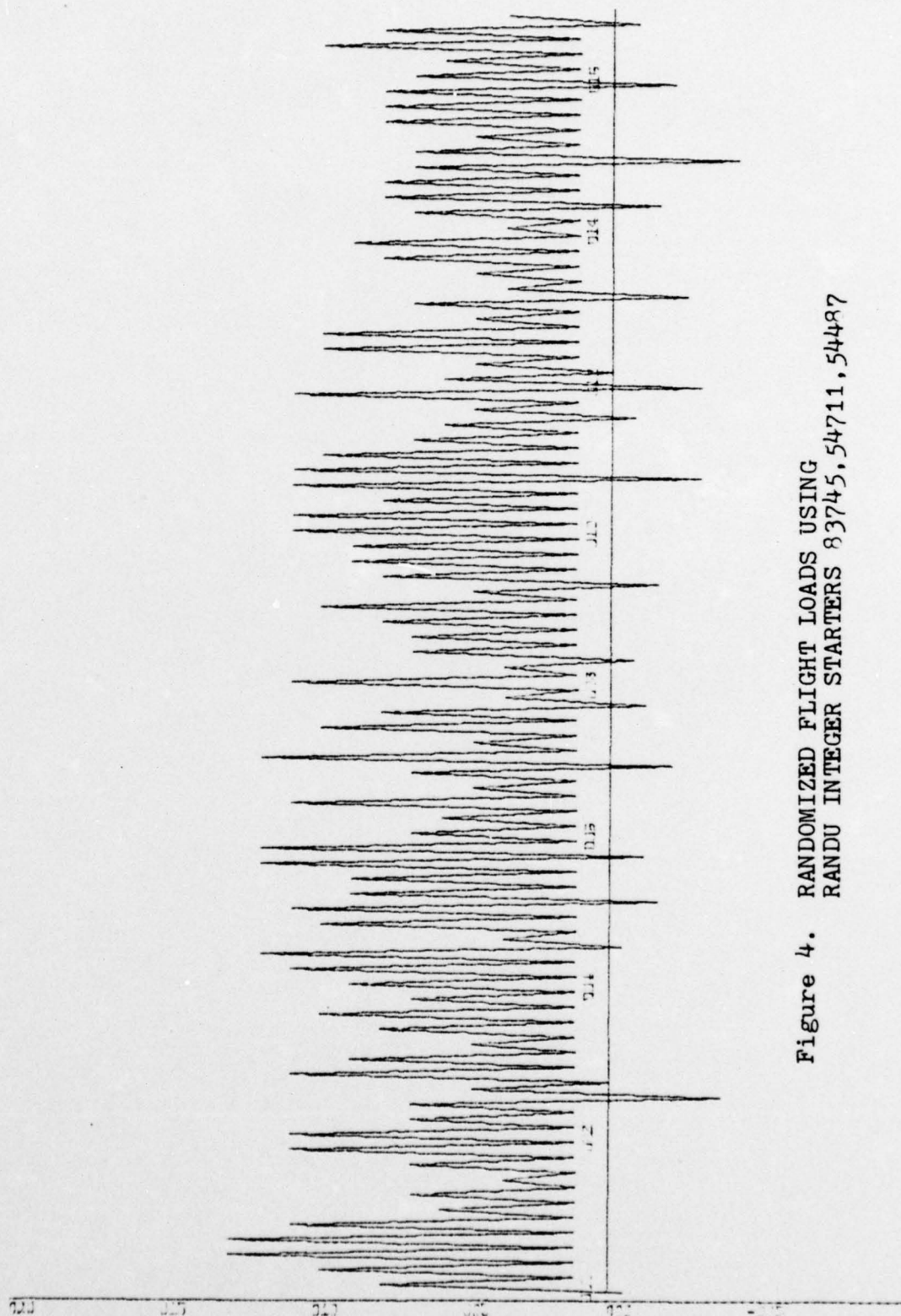


the local residual compressive stress caused by positive loads into the plastic zone. This permits the local positive elastic stresses to be more damaging.

Six plots are presented, beginning on page 33, to illustrate the pattern of the individual load randomization process. Each plot portrays the first two flight hours of the aircraft. The range of values in the columns of Table III are caused by such variations in the load randomization pattern.

The fatigue damage resulting from randomization of loads on a cycle basis, as shown in Table III, is significantly different from the damage due to the HI-LO-HI block loads illustrated in Table II. Vought Aeronautics Division conducted a fatigue study using randomized flights. Each flight was based on a mission profile specified by the Air Force. Fatigue damage resulting from the randomized flights was in close agreement with fatigue damage resulting from HI-LO-HI block loading.

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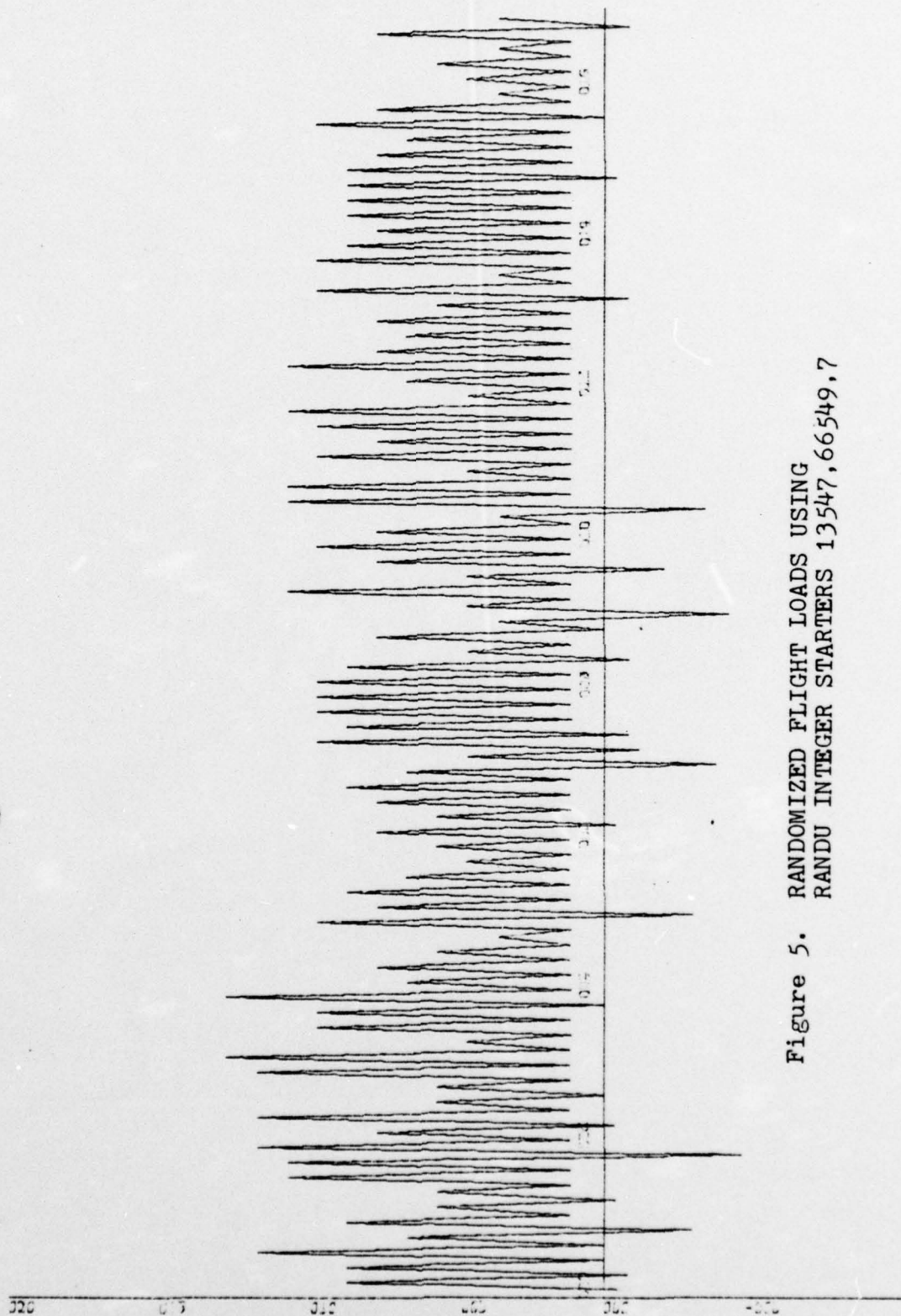


Figure 5. RANDOMIZED FLIGHT LOADS USING  
RANDU INTEGER STARTERS 13547,66549,7



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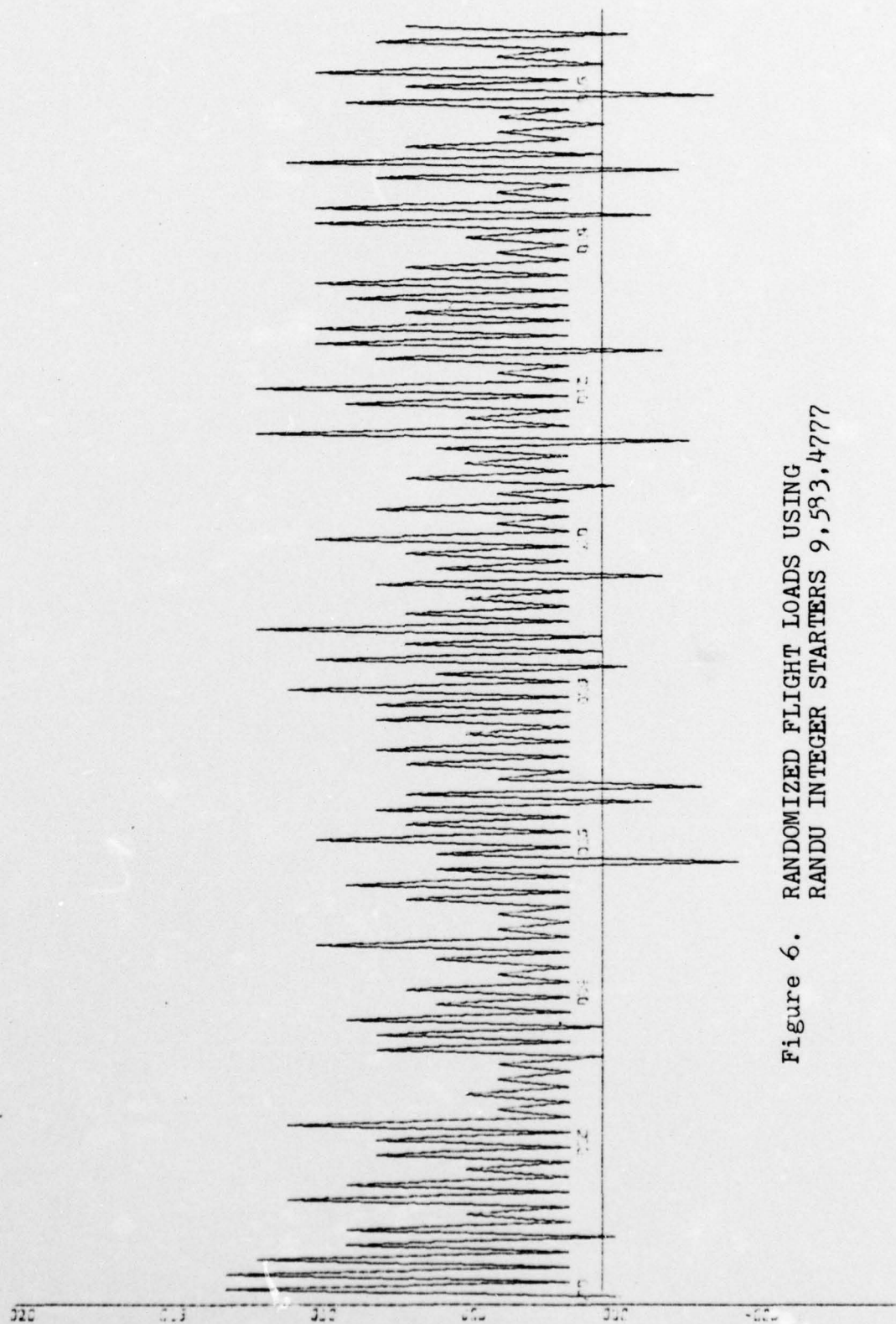


Figure 6. RANDOMIZED FLIGHT LOADS USING  
RANDU INTEGER STARTERS 9,593,4777

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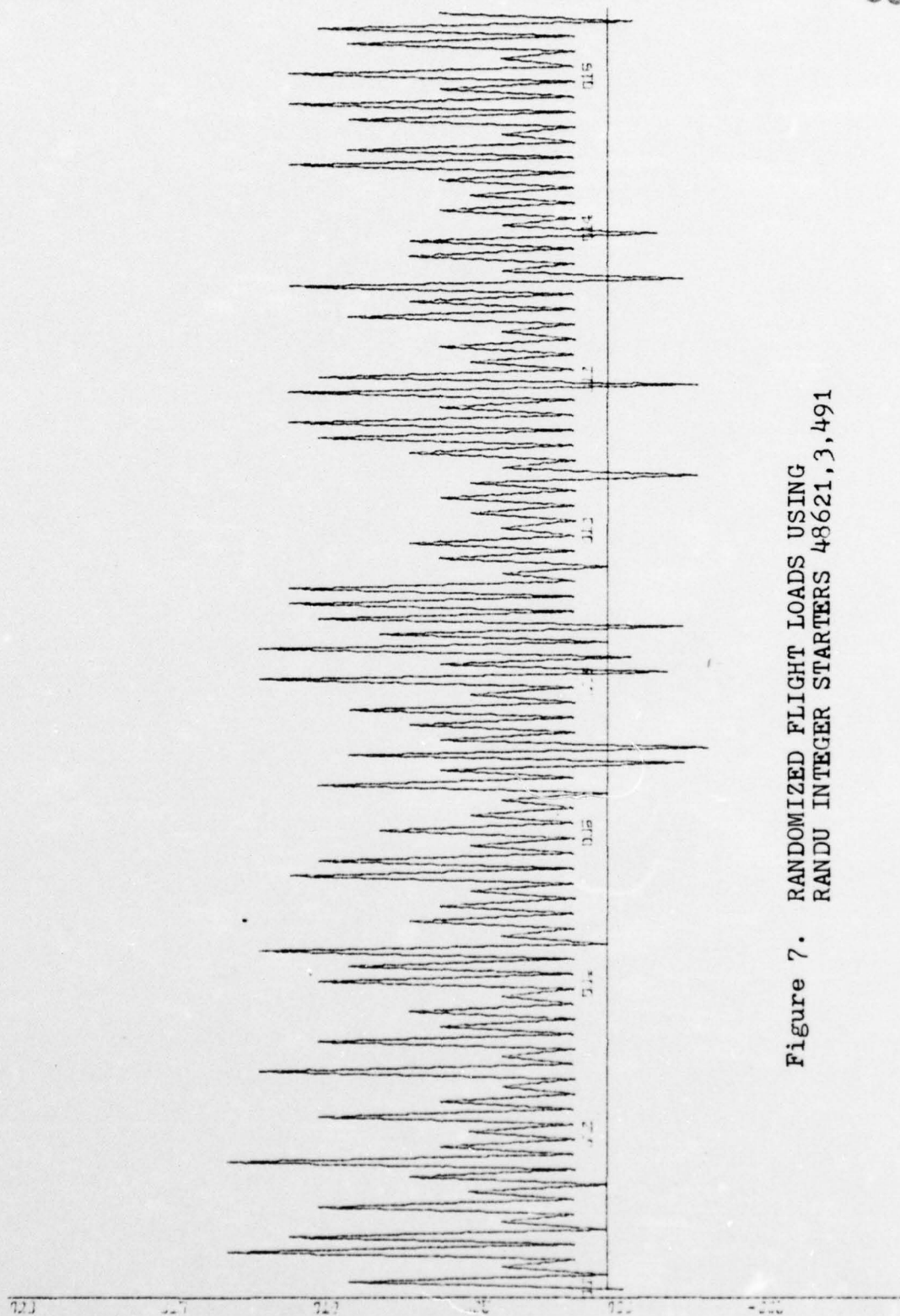
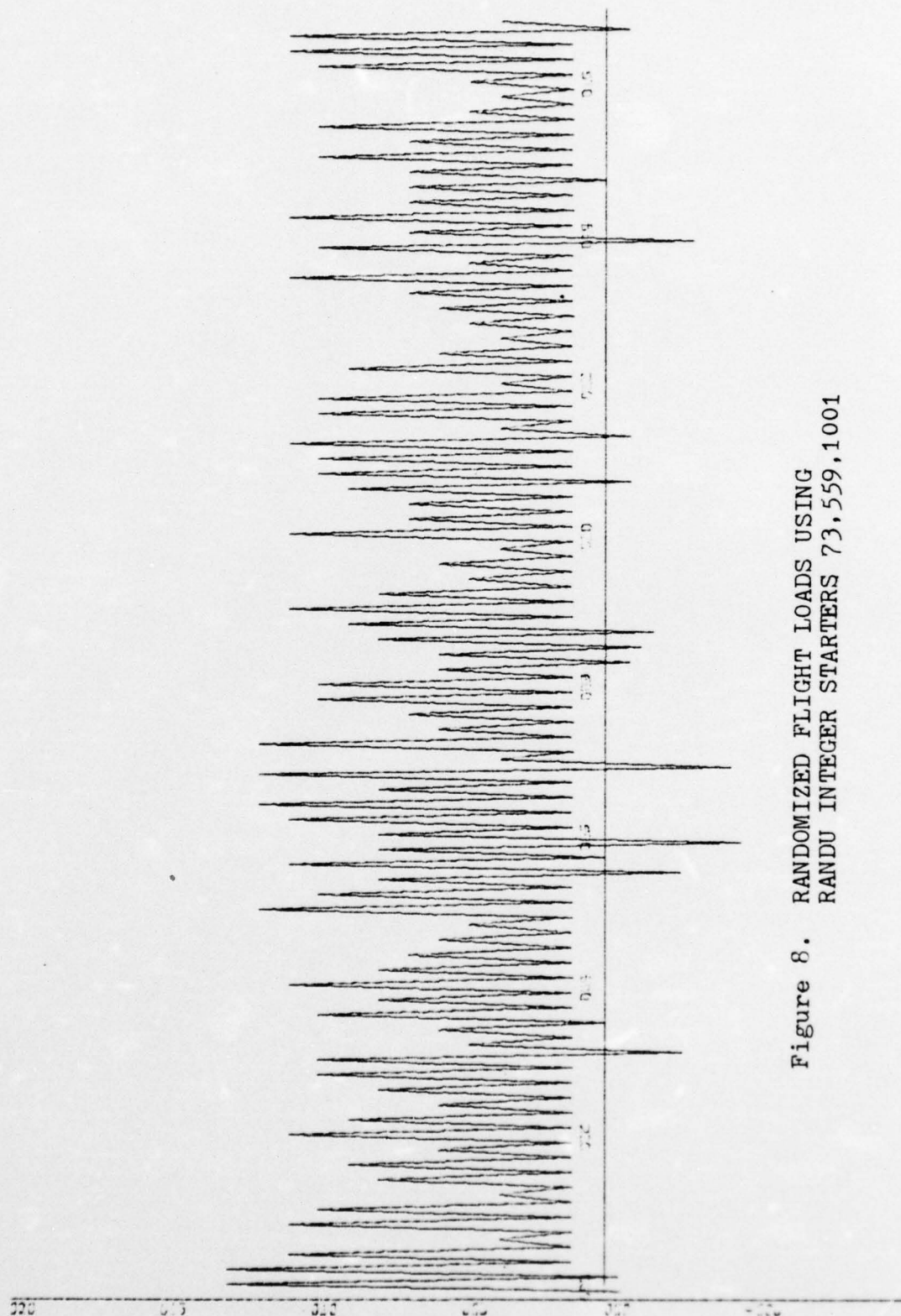


Figure 7. RANDOMIZED FLIGHT LOADS USING  
RANDU INTEGER STARTERS 48621, 3, 491

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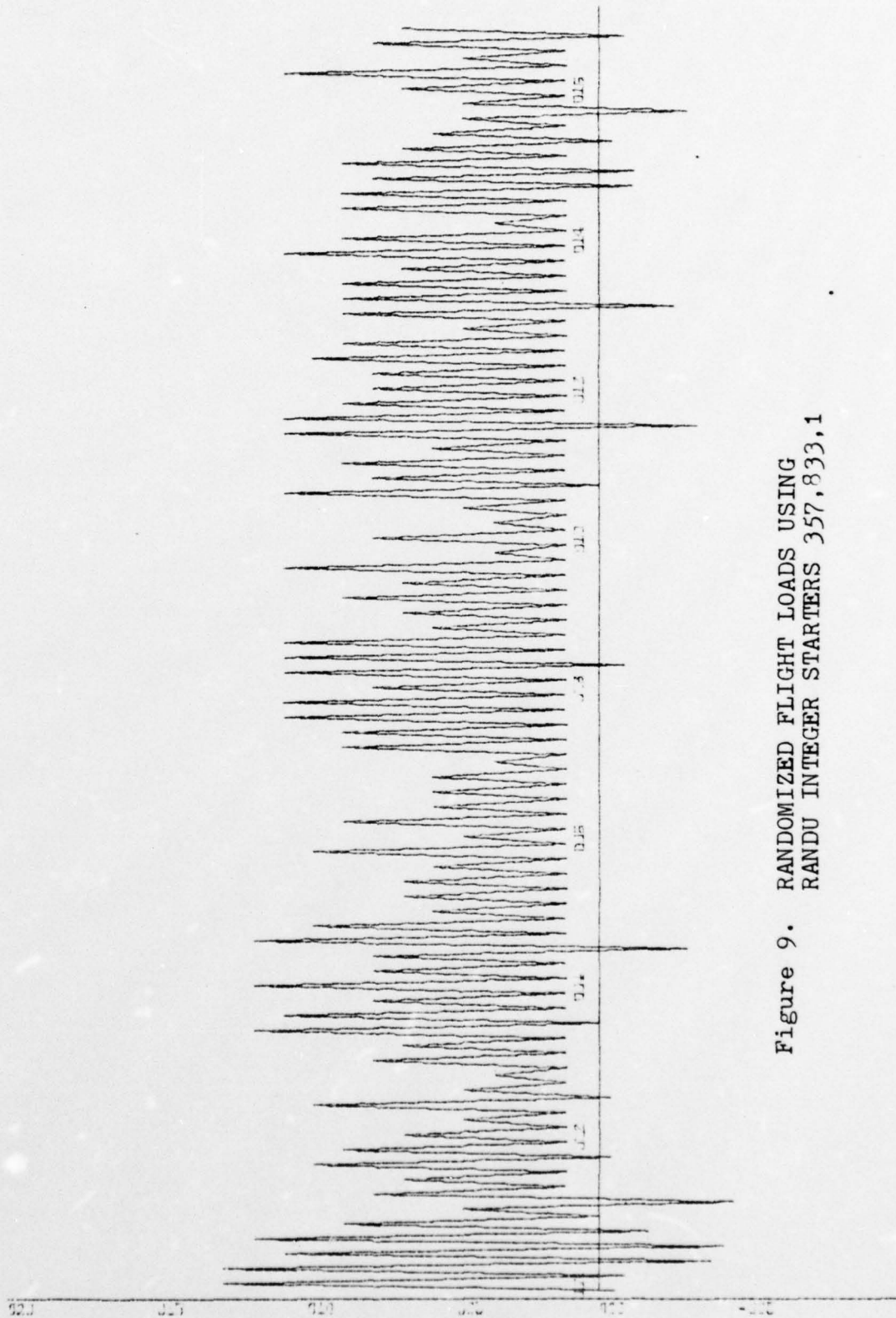


Figure 9. RANDOMIZED FLIGHT LOADS USING  
RANDU INTEGER STARTERS 357,833,1

#### IV. RECOMMENDATIONS FOR FUTURE RESEARCH

Subsequent work in this area should be directed toward refining the input load sequence. The Naval Air Development Center collects accelerometer data from individual aircraft on a monthly basis. These load data could be used in this computer program to see if randomizing the load sequence over the life of the structure provides a different picture of the fatigue damage than randomizing by the month. Also, research is needed to determine the magnitude and sequence of the ground cycles. In this analysis all ground cycles were considered of equal magnitude and equal spacing, which is not the case with a real airplane. A landing load spectrum should be used to be more accurate.

The computer program itself could be improved by a better understanding and definition of the relaxation phenomena. Experiments to quantify the relaxation parameters will enhance the program.

The Air Force is monitoring crack growth as the basis for their fatigue damage assessment. It would be productive to compare the total fatigue damage calculated by the two methods.

## INPLT GF BLOCK LOADS

A7 CRITICAL POINT #1 FROM U166808	
7075-76 AL	72.2801
	.5154
	.6141
	.6838
	.0020
	.0022
	.0014
	.0013
	1000000.

16.	140.	150.	140.	1360.	12500.	4500.	6500.	17000.
16.	140.	150.	140.	1360.	12500.	4500.	6500.	17000.
140.	150.	140.	1360.	12500.	4500.	6500.	17000.	
150.	140.	1360.	12500.	4500.	6500.	17000.		
140.	1360.	12500.	4500.	6500.	17000.			
1360.	12500.	4500.	6500.	17000.				
12500.	4500.	6500.	17000.					
4500.	6500.	17000.						
6500.	17000.							
17000.								



OUTPUT OF BLOCK LOADS, IPRINT = 1

1 DATA DECKS ARE TO BE PROCESSED.  
SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION



1 19 9 8 7 6 5 4 3 2 1  
2 1 2 3 4 5 6 7 8 9 10



SPECTRUM FROM A7 CRITICAL POINT #1 FROM U166808

AKT = 2.72

RELAXATION CONSTANT C1= 1000000.00

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE

FLIGHT CR BLOCK NO.	SIGMAX	SIGMIN	RES	EQRES	ENR	NEP		
37.25	72.00	-20.40	0.0	-29.32	16.00	0.17906543E 04	1	1
34.27	63.89	-20.40	-29.32	-21.21	40.00	0.21008384E 04	2	2
RELAXATION	3.28	-20.35			4.00			
RELAXATION	3.28	-20.32			4.00			
RELAXATION	3.28	-20.28			4.00			
RELAXATION	3.28	-20.25			4.00			
RELAXATION	3.28	-20.21			4.00			
RELAXATION	3.28	-20.18			4.00			
RELAXATION	3.28	-20.14			4.00			
RELAXATION	3.28	-20.07			4.00			
RELAXATION	3.28	-20.06			4.00			
RELAXATION	3.28	-19.95			4.00			
RELAXATION	3.28	-19.73			4.00			
RELAXATION	3.28	-19.52			4.00			
RELAXATION	3.28	-19.31			4.00			
RELAXATION	3.28	-19.10			4.00			
RELAXATION	3.28	-18.90			4.00			
RELAXATION	3.28	-18.69			4.00			
RELAXATION	3.28	-18.49			4.00			
RELAXATION	3.28	-18.30			4.00			
RELAXATION	3.28	-18.10			4.00			
RELAXATION	3.28	-18.01			4.00			
RELAXATION	3.28	-17.94			4.00			
RELAXATION	3.28	-16.94			4.00			
RELAXATION	3.28	-16.25			4.00			
RELAXATION	3.28	-15.58			4.00			
RELAXATION	3.28	-14.94			4.00			
RELAXATION	3.28	-14.32			4.00			
RELAXATION	3.28	-13.72			4.00			
RELAXATION	3.28	-13.14			4.00			
RELAXATION	3.28	-12.58			4.00			
RELAXATION	3.28	-12.03			4.00			
RELAXATION	3.28	-11.46			4.00			
RELAXATION	3.28	-10.93			4.00			
RELAXATION	3.28	-9.33			4.00			
RELAXATION	3.28	-8.76			4.00			
RELAXATION	3.28	-8.19			4.00			
RELAXATION	3.28	-7.62			4.00			
RELAXATION	3.28	-7.05			4.00			
RELAXATION	3.28	-6.48			4.00			
RELAXATION	3.28	-5.91			4.00			
RELAXATION	3.28	-5.34			4.00			
RELAXATION	3.28	-4.77			4.00			
RELAXATION	3.28	-4.20			4.00			
RELAXATION	3.28	-3.63			4.00			
RELAXATION	3.28	-3.06			4.00			
RELAXATION	3.28	-2.49			4.00			
RELAXATION	3.28	-1.92			4.00			
RELAXATION	3.28	-1.35			4.00			
RELAXATION	3.28	-0.78			4.00			
RELAXATION	3.28	-0.21			4.00			
RELAXATION	3.28	0.36			4.00			
RELAXATION	3.28	0.93			4.00			
RELAXATION	3.28	1.50			4.00			
RELAXATION	3.28	2.07			4.00			
RELAXATION	3.28	2.64			4.00			
RELAXATION	3.28	3.21			4.00			
RELAXATION	3.28	3.78			4.00			
RELAXATION	3.28	4.35			4.00			
RELAXATION	3.28	4.92			4.00			
RELAXATION	3.28	5.49			4.00			
RELAXATION	3.28	6.06			4.00			
RELAXATION	3.28	6.63			4.00			
RELAXATION	3.28	7.20			4.00			
RELAXATION	3.28	7.77			4.00			
RELAXATION	3.28	8.34			4.00			
RELAXATION	3.28	8.91			4.00			
RELAXATION	3.28	9.48			4.00			
RELAXATION	3.28	10.05			4.00			
RELAXATION	3.28	10.62			4.00			
RELAXATION	3.28	11.19			4.00			
RELAXATION	3.28	11.76			4.00			
RELAXATION	3.28	12.33			4.00			
RELAXATION	3.28	12.90			4.00			
RELAXATION	3.28	13.47			4.00			
RELAXATION	3.28	14.04			4.00			
RELAXATION	3.28	14.61			4.00			
RELAXATION	3.28	15.18			4.00			
RELAXATION	3.28	15.75			4.00			
RELAXATION	3.28	16.32			4.00			
RELAXATION	3.28	16.89			4.00			
RELAXATION	3.28	17.46			4.00			
RELAXATION	3.28	18.03			4.00			
RELAXATION	3.28	18.60			4.00			
RELAXATION	3.28	19.17			4.00			
RELAXATION	3.28	19.74			4.00			
RELAXATION	3.28	20.31			4.00			
RELAXATION	3.28	20.88			4.00			
RELAXATION	3.28	21.45			4.00			
RELAXATION	3.28	22.02			4.00			
RELAXATION	3.28	22.59			4.00			
RELAXATION	3.28	23.16			4.00			
RELAXATION	3.28	23.73			4.00			
RELAXATION	3.28	24.30			4.00			
RELAXATION	3.28	24.87			4.00			
RELAXATION	3.28	25.44			4.00			
RELAXATION	3.28	26.01			4.00			
RELAXATION	3.28	26.58			4.00			
RELAXATION	3.28	27.15			4.00			
RELAXATION	3.28	27.72			4.00			
RELAXATION	3.28	28.29			4.00			
RELAXATION	3.28	28.86			4.00			
RELAXATION	3.28	29.43			4.00			
RELAXATION	3.28	30.00			4.00			
RELAXATION	3.28	30.57			4.00			
RELAXATION	3.28	31.14			4.00			
RELAXATION	3.28	31.71			4.00			
RELAXATION	3.28	32.28			4.00			
RELAXATION	3.28	32.85			4.00			
RELAXATION	3.28	33.42			4.00			
RELAXATION	3.28	33.99			4.00			
RELAXATION	3.28	34.56			4.00			
RELAXATION	3.28	35.13			4.00			
RELAXATION	3.28	35.70			4.00			
RELAXATION	3.28	36.27			4.00			
RELAXATION	3.28	36.84			4.00			
RELAXATION	3.28	37.41			4.00			
RELAXATION	3.28	37.98			4.00			
RELAXATION	3.28	38.55			4.00			
RELAXATION	3.28	39.12			4.00			
RELAXATION	3.28	39.69			4.00			
RELAXATION	3.28	40.26			4.00			
RELAXATION	3.28	40.83			4.00			
RELAXATION	3.28	41.40			4.00			
RELAXATION	3.28	41.97			4.00			
RELAXATION	3.28	42.54			4.00			
RELAXATION	3.28	43.11			4.00			
RELAXATION	3.28	43.68			4.00			
RELAXATION	3.28	44.25			4.00			
RELAXATION	3.28	44.82			4.00			
RELAXATION	3.28	45.39			4.00			
RELAXATION	3.28	45.96			4.00			
RELAXATION	3.28	46.53			4.00			
RELAXATION	3.28	47.10			4.00			
RELAXATION	3.28	47.67			4.00			
RELAXATION	3.28	48.24			4.00			
RELAXATION	3.28	48.81			4.00			
RELAXATION	3.28	49.38			4.00			
RELAXATION	3.28	49.95			4.00			
RELAXATION	3.28	50.52			4.00			
RELAXATION	3.28	51.09			4.00			
RELAXATION	3.28	51.66			4.00			
RELAXATION	3.28	52.23			4.00			
RELAXATION	3.28	52.80			4.00			
RELAXATION	3.28	53.37			4.00			
RELAXATION	3.28	53.94			4.00			
RELAXATION	3.28	54.51			4.00			
RELAXATION	3.28	55.08			4.00			
RELAXATION	3.28	55.65			4.00			
RELAXATION	3.28	56.22			4.00			
RELAXATION	3.28	56.79			4.00			
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RELAXATION	3.28	57.93			4.00			
RELAXATION	3.28	58.50			4.00			
RELAXATION	3.28	59.07			4.00			
RELAXATION	3.28	59.64			4.00			
RELAXATION	3.28	60.21			4.00			
RELAXATION	3.28	60.78			4.00			
RELAXATION	3.28	61.35			4.00			
RELAXATION	3.28	61.92			4.00			
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RELAXATION	3.28	63.06			4.00			
RELAXATION	3.28	63.63			4.00			
RELAXATION	3.28	64.20			4.00			
RELAXATION	3.28	64.77			4.00			
RELAXATION	3.28	65.34			4.00			
RELAXATION	3.28	65.91			4.00			
RELAXATION	3.28	66.48			4.00			
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RELAXATION	3.28	67.62			4.00			
RELAXATION	3.28	68.19			4.00			
RELAXATION	3.28	68.76			4.00			
RELAXATION	3.28	69.33			4.00			
RELAXATION	3.28	69.90			4.00			
RELAXATION	3.28	70.47			4.00			
RELAXATION	3.28	71.04			4.00			
RELAXATION	3.28	71.61			4.00			
RELAXATION	3.28	72.18			4.00			
RELAXATION	3.28	72.75			4.00			
RELAXATION	3.28	73.32			4.00			
RELAXATION	3.28	73.89			4.00			
RELAXATION	3.28	74.46			4.00			
RELAXATION	3.28	75.03			4.00			
RELAXATION	3.28	75.60			4.00			
RELAXATION	3.28	76.17			4.00			
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RELAXATION	3.28	77.88			4.00			
RELAXATION	3.28	78.45			4.00			
RELAXATION	3.28	79.02			4.00			
RELAXATION	3.28	79.59			4.00			
RELAXATION	3.28	80.16			4.00			
RELAXATION	3.28	80.73			4.00			
RELAXATION	3.28	81.30			4.00			
RELAXATION	3.28	81.87			4.00			
RELAXATION	3.28	82.44			4.00			
RELAXATION	3.28	83.01			4.00			
RELAXATION	3.28	83.58			4.00			
RELAXATION	3.28	84.15			4.00			
RELAXATION	3.28	84.72			4.00			
RELAXATION	3.28	85.29			4.00			
RELAXATION								



STEP	RANGE PAIR	CYCLE COUNTED	SPECTRUM	SIGMA	MAXIMUM	MINIMUM	COUNTER K
190	5769833	02	02	0.0	0.720000E 02	-0.24038E 02	16.00000
122	578946E	02	02	0.0	0.639121E 02	-0.203860E 02	4.00000
223	580882E	02	02	0.0	0.639475E 02	-0.203507E 02	4.00000
223	0.511509	02	02	0.0	0.639827E 02	-0.203154E 02	4.00000
223	0.518382E	02	02	0.0			
223	0.525028E	02	02	0.0			
223	0.531456E	02	02	0.0			
223	0.537671E	02	02	0.0			
223	0.543368E	02	02	0.0			
223	0.549494E	02	02	0.0			
223	0.555115E	02	02	0.0			
223	0.560550E	02	02	0.0			
223	0.566478E	02	02	0.0			
223	0.5721174E	02	02	0.0			
223	0.5785512E	02	02	0.0			
223	0.585041E	02	02	0.0			
223	0.5915745E	02	02	0.0			
223	0.5983398E	02	02	0.0			
223	0.6053729E	02	02	0.0			
223	0.612956E	02	02	0.0			
223	0.62173E	02	02	0.0			
223	0.631956E	02	02	0.0			
223	0.642277E	02	02	0.0			
223	0.654277E	02	02	0.0			
223	0.667427E	02	02	0.0			
223	0.682077E	02	02	0.0			
223	0.698337E	02	02	0.0			
223	0.719091E	02	02	0.0			
223	0.740901E	02	02	0.0			
223	0.7633561E	02	02	0.0			
223	0.78946E	02	02	0.0			
223	0.822E	02	02	0.0			
223	0.859E	02	02	0.0			
223	0.894E	02	02	0.0			
223	0.931E	02	02	0.0			
223	0.968E	02	02	0.0			
223	1.005E	02	02	0.0			
223	1.042E	02	02	0.0			
223	1.079E	02	02	0.0			
223	1.116E	02	02	0.0			
223	1.153E	02	02	0.0			
223	1.190E	02	02	0.0			
223	1.227E	02	02	0.0			
223	1.264E	02	02	0.0			
223	1.301E	02	02	0.0			
223	1.338E	02	02	0.0			
223	1.375E	02	02	0.0			
223	1.412E	02	02	0.0			
223	1.449E	02	02	0.0			
223	1.486E	02	02	0.0			
223	1.523E	02	02	0.0			
223	1.560E	02	02	0.0			
223	1.597E	02	02	0.0			
223	1.634E	02	02	0.0			
223	1.671E	02	02	0.0			
223	1.708E	02	02	0.0			
223	1.745E	02	02	0.0			
223	1.782E	02	02	0.0			
223	1.819E	02	02	0.0			
223	1.856E	02	02	0.0			
223	1.893E	02	02	0.0			
223	1.930E	02	02	0.0			
223	1.967E	02	02	0.0			
223	2.004E	02	02	0.0			
223	2.041E	02	02	0.0			
223	2.078E	02	02	0.0			
223	2.115E	02	02	0.0			
223	2.152E	02	02	0.0			
223	2.189E	02	02	0.0			
223	2.226E	02	02	0.0			
223	2.263E	02	02	0.0			
223	2.300E	02	02	0.0			
223	2.337E	02	02	0.0			
223	2.374E	02	02	0.0			
223	2.411E	02	02	0.0			
223	2.448E	02	02	0.0			
223	2.485E	02	02	0.0			
223	2.522E	02	02	0.0			
223	2.559E	02	02	0.0			
223	2.596E	02	02	0.0			
223	2.633E	02	02	0.0			
223	2.670E	02	02	0.0			
223	2.707E	02	02	0.0			
223	2.744E	02	02	0.0			
223	2.781E	02	02	0.0			
223	2.818E	02	02	0.0			
223	2.855E	02	02	0.0			
223	2.892E	02	02	0.0			
223	2.929E	02	02	0.0			
223	2.966E	02	02	0.0			
223	3.003E	02	02	0.0			
223	3.040E	02	02	0.0			
223	3.077E	02	02	0.0			
223	3.114E	02	02	0.0			
223	3.151E	02	02	0.0			
223	3.188E	02	02	0.0			
223	3.225E	02	02	0.0			
223	3.262E	02	02	0.0			
223	3.299E	02	02	0.0			
223	3.336E	02	02	0.0			
223	3.373E	02	02	0.0			
223	3.410E	02	02	0.0			
223	3.447E	02	02	0.0			
223	3.484E	02	02	0.0			
223	3.521E	02	02	0.0			
223	3.558E	02	02	0.0			
223	3.595E	02	02	0.0			
223	3.632E	02	02	0.0			
223	3.669E	02	02	0.0			
223	3.706E	02	02	0.0			
223	3.743E	02	02	0.0			
223	3.780E	02	02	0.0			
223	3.817E	02	02	0.0			
223	3.854E	02	02	0.0			
223	3.891E	02	02	0.0			
223	3.928E	02	02	0.0			
223	3.965E	02	02	0.0			
223	4.002E	02	02	0.0			
223	4.039E	02	02	0.0			
223	4.076E	02	02	0.0			
223	4.113E	02	02	0.0			
223	4.150E	02	02	0.0			
223	4.187E	02	02	0.0			
223	4.224E	02	02	0.0			
223	4.261E	02	02	0.0			
223	4.298E	02	02	0.0			
223	4.335E	02	02	0.0			
223	4.372E	02	02	0.0			
223	4.409E	02	02	0.0			
223	4.446E	02	02	0.0			
223	4.483E	02	02	0.0			
223	4.520E	02	02	0.0			
223	4.557E	02	02	0.0			
223	4.594E	02	02	0.0			
223	4.631E	02	02	0.0			
223	4.668E	02	02	0.0			
223	4.705E	02	02	0.0			
223	4.742E	02	02	0.0			
223	4.779E	02	02	0.0			
223	4.816E	02	02	0.0			
223	4.853E	02	02	0.0			
223	4.890E	02	02	0.0			
223	4.927E	02	02	0.0			
223	4.964E	02	02	0.0			
223	5.001E	02	02	0.0			
223	5.038E	02	02	0.0			
223	5.075E	02	02	0.0			
223	5.112E	02	02	0.0			
223	5.149E	02	02	0.0			
223	5.186E	02	02	0.0			
223	5.223E	02	02	0.0			
223	5.260E	02	02	0.0			
223	5.297E	02	02	0.0			
223	5.334E	02	02	0.0			
223	5.371E	02	02	0.0			
223	5.408E	02	02	0.0			
223	5.445E	02	02	0.0			
223	5.482E	02	02	0.0			
223	5.519E	02	02	0.0			
223	5.556E	02	02	0.0			
223	5.593E	02	02	0.0			
223	5.630E	02	02	0.0			
223	5.667E	02	02	0.0			
223	5.704E	02	02	0.0			
223	5.741E	02	02	0.0			
223	5.778E	02	02	0.0			
223	5.815E	02	02	0.0			
223	5.852E	02	02	0.0			
223	5.889E	02	02	0.0			
223	5.926E	02	02	0.0			
223	5.963E	02	02	0.0			
223	6.000E	02	02	0.0			
223	6.037E	02	02	0.0			
223	6.074E	02	02	0.0			
223	6.111E	02	02	0.0			
223	6.148E	02	02	0.0			
223	6.185E	02	02	0.0			
223	6.222E	02	02	0.0			
223	6.259E	02	02	0.0			
223	6.296E	02	02	0.0			
223	6.333E	02	02	0.0			
223	6.370E	02	02	0.0			
223	6.407E	02	02	0.0			
223	6.444E	02	02	0.0			
223	6.481E	02	02	0.0			
223	6.518E	02	02	0.0			
223	6.555E	02	02	0.0			
223	6.592E	02	02	0.0			
223	6.629E	02	02	0.0			
223	6.666E	02	02	0.0			
223	6.703E	02	02	0.0			
223	6.740E	02	02	0.0			
223	6.777E	02	02	0.0			
223	6.814E	02	02	0.0			
223	6.851E	02	02	0.0			
223	6.888E	02	02	0.0			
223	6.925E	02	02	0.0			
223	6.962E	02	02	0.0			
223	7.000E	02	02	0.0			
223	7.037E	02	02	0.0			
223	7.074E	02	02	0.0			
223	7.111E	02	02	0.0			
223	7.148E	02	02	0.0			
223	7.185E	02	02	0.0			
223	7.222E	02	02	0.0			
223	7.259E	02	02	0.0			
223	7.296E	02	02	0.0			
223	7.333E	02	02				





53  
54  
55

0.440901E 02  
0.363929E 02  
0.283561E 02

0.842553E C1  
0.863383E 01  
0.850269E 01

6500.00000  
9500.00000  
\*\*\*\*\*

# LOCAL STRESSES AND PLASTIC STRAINS WITH RESULTING FATIGUE LIFE

STEP 1  
PLASTIC STRAIN 0.00706  
DAMAGE FROM PLASTIC STRAINS= 0.603661E-03  
DAMAGE 0.603661E-03

SIGMAX	SIGMIN	RMCYC	CYCLES	ENN/CYC	DAMAGE
72.00	-20.40	16.	99599805E	0.16000031E-02	0.00000000
63.91	-20.39	4.	0.105511C9E	0.36393036E-03	0.00000000
63.95	-20.35	4.	0.10971137E	0.36455330E-03	0.00000000
63.98	-20.32	4.	0.10551203E	0.36525656E-03	0.00000000
64.02	-20.28	4.	0.10538156E	0.36569219E-03	0.00000000
64.05	-20.25	4.	0.10931410E	0.36591780E-03	0.00000000
64.09	-20.21	4.	0.10919895E	0.36630384E-03	0.00000000
64.12	-20.18	4.	0.10897375E	0.36706077E-03	0.00000000
64.16	-20.14	4.	0.10886496E	0.36742748E-03	0.00000000
64.19	-20.11	4.	0.10866233E	0.36811247E-03	0.00000000
64.23	-20.07	4.	0.10866233E	0.36810944E-03	0.00000000
56.46	-19.95	15.	0.20355750E	0.73689246E-03	0.00000000
56.67	-19.52	15.	0.20136533E	0.74485957E-03	0.00000000
56.89	-19.31	15.	0.19923333E	0.75288606E-03	0.00000000
57.09	-19.10	15.	0.19717730E	0.76075331E-03	0.00000000
57.30	-18.90	15.	0.19512488E	0.76873833E-03	0.00000000
57.50	-18.69	15.	0.19313887E	0.77664338E-03	0.00000000
57.70	-18.49	15.	0.19118684E	0.78457226E-03	0.00000000
57.89	-18.30	15.	0.18930270E	0.79233815E-03	0.00000000
58.09	-18.10	15.	0.18745156E	0.80020654E-03	0.00000000
58.44	-17.94	44.	0.46133058E	0.91145444E-03	0.00000000
51.84	-16.25	44.	0.42227764E	0.95382221E-03	0.00000000
51.50	-15.58	44.	0.40551523E	0.99565221E-03	0.00000000
53.17	-14.32	44.	0.38537594E	1.04073392E-02	0.00000000
53.37	-13.72	44.	0.37433042E	1.08500133E-02	0.00000000
54.95	-13.15	44.	0.36023719E	1.11755142E-02	0.00000000
55.51	-12.58	44.	0.34707324E	1.22677484E-02	0.00000000
55.65	-12.03	44.	0.33407324E	1.31444810E-02	0.00000000
49.06	-10.93	136.	0.11033349E	0.12332610E-02	0.00000000
50.65	-9.86	136.	0.09721018E	0.13590302E-02	0.00000000
53.47	-7.52	136.	0.08635444E	0.15745044E-02	0.00000000
54.71	-5.51	136.	0.06973368E	0.17591274E-02	0.00000000





28.31	3.28	50.08	-18.01	-26.92	-5.00	44C.00	0.302255C7E	C4	4	22	22
RELAXATION		50.44	-17.65			44.00					23
RELAXATION		51.15	-16.25			44.00					24
RELAXATION		51.84	-16.25			44.00					25
RELAXATION		52.50	-15.94			44.00					26
RELAXATION		53.15	-14.32			44.00					27
RELAXATION		53.77	-14.32			44.00					28
RELAXATION		54.35	-13.14			44.00					29
RELAXATION		54.95	-12.58			44.00					30
RELAXATION		55.51	-12.03			44.00					31
RELAXATION		56.06	-11.93			44.00					32
RELAXATION	3.28	48.22	-10.93	-20.68	0.0	***	0.37305303E	C4	5	32	33
RELAXATION		49.05	-9.33			136.00					34
RELAXATION		50.65	-7.86			136.00					35
RELAXATION		52.12	-6.51			136.00					36
RELAXATION		53.47	-5.27			136.00					37
RELAXATION		54.71	-4.13			136.00					38
RELAXATION		55.85	-3.08			136.00					39
RELAXATION		56.90	-2.11			136.00					40
RELAXATION		57.87	-1.22			136.00					41
RELAXATION		58.76	-0.41			***					42
RELAXATION	3.28	59.57	-0.50	-8.93	0.0	***	0.47195547E	C4	6	42	43
RELAXATION		51.86	0.50			25C.00					44
RELAXATION		52.37	1.46			25C.00					45
RELAXATION		53.34	2.32			25C.00					46
RELAXATION		54.20	3.08			25C.00					47
RELAXATION		55.95	3.75			25C.00					48
RELAXATION		56.62	4.34			25C.00					49
RELAXATION		57.24	4.87			25C.00					50
RELAXATION		57.98	5.33			25C.00					51
RELAXATION		57.62	5.74			***	0.61621797E	C4	7	52	
RELAXATION	3.28	50.05	6.28	-2.64	0.0	***	0.83860000E	C4	8	53	
RELAXATION		44.09	8.43	-0.49	0.0	***	0.12079809E	C5	9	54	
RELAXATION	3.28	36.39	8.83	-0.08	0.0	***	0.18907535E	C5	10	55	
RELAXATION		28.36	8.90	-0.01	0.0	***					

LOCAL STRESSES AND PLASTIC STRAINS WITH RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	DAMAGE FROM PLASTIC STRAINS=	MAX CR MIN	DAMAGE
1	0.00706	0.6032392E-03		0.6032392E-03
SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
72.00	-20.40	16.	0.99559805E 04	0.16000031E-02
63.91	-20.39	4.	0.10991109E 05	0.36393036E-03



57.98  
50.05  
44.09  
36.39  
28.36

6.11  
6.28  
8.43  
8.83  
8.90

250.  
4500.  
6500.  
9500.  
17000.

0.11300669E 06 C.22122583E-02  
0.81512081E 06 0.55206530E-02  
0.77923370E 07 0.83415280E-03  
0.20005553E 09 0.47486101E-04  
0.47726305E 10 0.35619769E-05

DAMAGE PER THIS SET= 0.69242597E-01

TOTAL ENN/CYC =, 0.13848418E 00



1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75																									

OUTPUT CF BLOCK LOADS, IPRINT = 1

1 DATA DECKS ARE TO BE PROCESSED.  
NO COUNTING METHODS USED  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION





1 10 1 1  
2 3 2 3  
3 8 3 7  
4 6 5 4  
5 9 6 3  
6 7 5 2  
7 4 4 1  
8 3 3 0  
9 8 2 9  
10 1 10

SPECTRUM FROM A7 CRITICAL PCINT #1 FROM U106808

AKT = 2.72

RELAXATION FLIGHT CR SIGMAX	CONSTANT BLOCK SIGMIN	C1=	10000000.00	RES	EQRES	ENN	NEP		
37.25	3.28	72.00	-20.40	0.0	-29.32	16.00	0.17906543E	04	1 1
37.27	3.28	63.89	-20.40	-29.32	-21.21	40.00	0.21008384E	04	2 2
RELAXATION		63.95	-20.35			4.00			
RELAXATION		63.98	-20.32			4.00			
RELAXATION		64.02	-20.28			4.00			
RELAXATION		64.05	-20.25			4.00			
RELAXATION		64.09	-20.21			4.00			
RELAXATION		64.12	-20.18			4.00			
RELAXATION		64.16	-20.14			4.00			
RELAXATION		64.19	-20.11			4.00			
RELAXATION		64.23	-20.07			4.00			
31.29	3.28	56.14	-20.06	-28.97	-13.11	150.00	C.24592734E	04	3 12
RELAXATION		56.25	-19.95			15.00			
RELAXATION		56.46	-19.73			15.00			
RELAXATION		56.67	-19.52			15.00			
RELAXATION		56.89	-19.31			15.00			
RELAXATION		57.09	-19.10			15.00			
RELAXATION		57.30	-18.90			15.00			
RELAXATION		57.50	-18.69			15.00			
RELAXATION		57.70	-18.49			15.00			
RELAXATION		57.89	-18.30			15.00			
RELAXATION		58.09	-18.10			15.00			
28.31	3.28	50.08	-18.01	-26.92	-5.00	440.00	0.30229507E	04	4 22
RELAXATION		50.44	-17.65			44.00			
RELAXATION		51.15	-16.94			44.00			
RELAXATION		51.84	-16.25			44.00			
RELAXATION		52.50	-15.58			44.00			
RELAXATION		53.15	-14.94			44.00			
RELAXATION		53.77	-14.32			44.00			
RELAXATION		54.37	-13.72			44.00			
RELAXATION		54.95	-13.14			44.00			
RELAXATION		55.51	-12.58			44.00			
RELAXATION		56.06	-12.03			44.00			
25.33	3.28	49.22	-11.76	-20.68	0.0	***	0.37305303E	04	5 32
RELAXATION		49.05	-11.09			136.00			
RELAXATION		50.65	-9.93			136.00			
RELAXATION		52.12	-7.86			136.00			
RELAXATION		53.47	-6.51			136.00			





57.89	18.49	15.	0.19	118684E	05	00.78	57268E	03
58.04	18.30	15.	0.18	130270E	05	00.79	2238155E	03
59.15	17.65	15.	0.18	1745156E	05	00.80	06444C	03
51.84	16.94	44.	0.46	1301722E	05	00.95	1452214E	03
52.50	16.25	44.	0.42	1377648E	05	00.95	073952E	02
53.58	15.94	44.	0.40	1551523E	05	00.10	0850352E	02
54.77	14.32	44.	0.38	1759422E	05	00.11	1300133E	02
55.95	13.72	44.	0.37	12273E	05	00.11	1755142E	02
56.51	13.14	44.	0.36	1027159E	05	00.12	14326E	02
57.06	12.58	44.	0.34	1733494E	05	00.12	2677481E	02
58.65	12.03	44.	0.33	1033281E	05	00.13	1448103E	02
59.05	10.93	136.	0.10	1721018E	05	00.13	266103E	02
50.12	9.86	136.	0.09	1354438E	05	00.15	590424E	02
51.47	7.51	136.	0.07	11188E	05	00.15	749042E	02
52.71	6.27	136.	0.06	13368E	05	00.17	502768E	02
53.90	4.13	136.	0.05	133538E	05	00.23	476089E	02
54.87	3.08	136.	0.05	1330816E	05	00.23	476277E	02
55.76	2.11	136.	0.05	1332765E	05	00.25	505966E	02
56.37	1.22	136.	0.04	1576052E	05	00.27	548425E	02
57.34	0.50	136.	0.02	1836645E	06	00.29	5849230E	02
58.20	0.46	250.	0.02	1656658E	06	00.13	611377E	02
59.33	0.32	250.	0.01	1556902E	06	00.14	851375E	02
54.62	0.08	250.	0.01	1452059E	06	00.16	575225E	02
55.74	0.34	250.	0.01	1364346E	06	00.17	2169233E	02
56.77	0.37	250.	0.01	1290578E	06	00.18	337933E	02
57.21	0.33	250.	0.01	1228241E	06	00.19	371163E	02
58.11	0.28	250.	0.01	1175270E	06	00.20	354706E	02
59.28	0.11	250.	0.01	1130066E	06	00.22	1271706E	02
50.05	0.06	4500.	0.00	1151208E	07	00.22	1225530E	02
51.39	0.00	9500.	0.00	1792337E	09	00.55	206530E	03
52.36	0.00	17000.	0.00	2005535E	10	00.83	415280E	04
						0.47	748610E	04
						0.35	615769E	05

DAMAGE PER THIS SET= 0.69243014E-01

TOTAL ENN/CYC =, 0.69243014E-01

FLIGHT	CF	BLOCK	NO.	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP
37.25	3.28	72.00	2	-20.40	-20.40	-0.01	-29.32	16.00	0.17906543E
34.27	3.28	63.89		-20.40	-20.40	-21.21	-21.21	4.00	0.21008384E
RELAXATION		63.91		-20.39	-20.39			4.00	
RELAXATION		63.95		-20.35	-20.35			4.00	
RELAXATION		63.98		-20.32	-20.32			4.00	

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49  
50  
51

RELAXATION : 57.21  
RELAXATION : 57.62  
RELAXATION : 57.98  
3.28 50.05  
3.28 44.09  
3.28 36.39  
10.43 28.36

25C.00  
25C.00  
25C.00  
0.0  
0.0  
0.0  
0.0

5.33  
5.74  
6.11  
6.28  
8.43  
8.83  
8.90

2.64  
-0.49  
-0.08  
-0.01

0.61621797E 04 7 52  
0.83860000E 04 8 53  
0.12079809E 05 9 54  
0.18907535E 05 10 55

LOCAL STRESSES AND PLASTIC STRAINS WITH RESULTING FATIGUE LIFE

STEP 1  
PLASTIC STRAIN 0.00706  
MAX CR MIN  
DAMAGE FROM PLASTIC STRAINS= 0.60323928E-03  
DAMAGE 0.60323928E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	DAMAGE	ENN/CYC	DAMAGE
72.00	-20.40	16.	0.99999805E	04	0.16000031E	-02
63.91	-20.39	4.	0.10991109E	05	0.36393036E	-03
63.95	-20.35	4.	0.10991113E	05	0.36455300E	-03
63.98	-20.32	4.	0.10991120E	05	0.36525656E	-03
64.05	-20.28	4.	0.10991156E	05	0.36555178E	-03
64.09	-20.25	4.	0.10991191E	05	0.36630384E	-03
64.12	-20.21	4.	0.10897375E	05	0.36706077E	-03
64.16	-20.14	4.	0.10886496E	05	0.36742748E	-03
64.19	-20.11	4.	0.10866233E	05	0.36810944E	-03
64.23	-20.07	15.	0.10866233E	05	0.36810944E	-03
56.46	-19.95	15.	0.20355275E	05	0.72878809E	-03
56.67	-19.73	15.	0.20355275E	05	0.72878809E	-03
56.89	-19.52	15.	0.20355275E	05	0.72878809E	-03
57.09	-19.31	15.	0.19523332E	05	0.74488997E	-03
57.30	-19.10	15.	0.19523332E	05	0.74488997E	-03
57.50	-18.90	15.	0.19523332E	05	0.74488997E	-03
57.70	-18.69	15.	0.19523332E	05	0.74488997E	-03
57.89	-18.49	15.	0.19523332E	05	0.74488997E	-03
58.09	-18.30	15.	0.19523332E	05	0.74488997E	-03
58.44	-18.10	15.	0.18744515E	05	0.78457226E	-03
58.89	-17.94	15.	0.18744515E	05	0.78457226E	-03
59.15	-17.75	15.	0.18744515E	05	0.78457226E	-03
59.40	-17.58	15.	0.18744515E	05	0.78457226E	-03
59.65	-17.42	15.	0.18744515E	05	0.78457226E	-03
59.90	-17.25	15.	0.18744515E	05	0.78457226E	-03
60.15	-17.09	15.	0.18744515E	05	0.78457226E	-03
60.40	-16.94	15.	0.18744515E	05	0.78457226E	-03
60.65	-16.78	15.	0.18744515E	05	0.78457226E	-03
60.90	-16.63	15.	0.18744515E	05	0.78457226E	-03
61.15	-16.48	15.	0.18744515E	05	0.78457226E	-03
61.40	-16.33	15.	0.18744515E	05	0.78457226E	-03
61.65	-16.18	15.	0.18744515E	05	0.78457226E	-03
61.90	-16.03	15.	0.18744515E	05	0.78457226E	-03
62.15	-15.88	15.	0.18744515E	05	0.78457226E	-03
62.40	-15.73	15.	0.18744515E	05	0.78457226E	-03
62.65	-15.58	15.	0.18744515E	05	0.78457226E	-03
62.90	-15.43	15.	0.18744515E	05	0.78457226E	-03
63.15	-15.28	15.	0.18744515E	05	0.78457226E	-03
63.40	-15.13	15.	0.18744515E	05	0.78457226E	-03
63.65	-14.98	15.	0.18744515E	05	0.78457226E	-03
63.90	-14.83	15.	0.18744515E	05	0.78457226E	-03
64.15	-14.68	15.	0.18744515E	05	0.78457226E	-03
64.40	-14.53	15.	0.18744515E	05	0.78457226E	-03
64.65	-14.38	15.	0.18744515E	05	0.78457226E	-03
64.90	-14.23	15.	0.18744515E	05	0.78457226E	-03
65.15	-14.08	15.	0.18744515E	05	0.78457226E	-03
65.40	-13.93	15.	0.18744515E	05	0.78457226E	-03
65.65	-13.78	15.	0.18744515E	05	0.78457226E	-03
65.90	-13.63	15.	0.18744515E	05	0.78457226E	-03
66.15	-13.48	15.	0.18744515E	05	0.78457226E	-03
66.40	-13.33	15.	0.18744515E	05	0.78457226E	-03
66.65	-13.18	15.	0.18744515E	05	0.78457226E	-03
66.90	-13.03	15.	0.18744515E	05	0.78457226E	-03
67.15	-12.88	15.	0.18744515E	05	0.78457226E	-03
67.40	-12.73	15.	0.18744515E	05	0.78457226E	-03
67.65	-12.58	15.	0.18744515E	05	0.78457226E	-03
67.90	-12.43	15.	0.18744515E	05	0.78457226E	-03
68.15	-12.28	15.	0.18744515E	05	0.78457226E	-03
68.40	-12.13	15.	0.18744515E	05	0.78457226E	-03
68.65	-11.98	15.	0.18744515E	05	0.78457226E	-03
68.90	-11.83	15.	0.18744515E	05	0.78457226E	-03
69.15	-11.68	15.	0.18744515E	05	0.78457226E	-03
69.40	-11.53	15.	0.18744515E	05	0.78457226E	-03
69.65	-11.38	15.	0.18744515E	05	0.78457226E	-03
69.90	-11.23	15.	0.18744515E	05	0.78457226E	-03
70.15	-11.08	15.	0.18744515E	05	0.78457226E	-03
70.40	-10.93	15.	0.18744515E	05	0.78457226E	-03
70.65	-10.78	15.	0.18744515E	05	0.78457226E	-03
70.90	-10.63	15.	0.18744515E	05	0.78457226E	-03
71.15	-10.48	15.	0.18744515E	05	0.78457226E	-03
71.40	-10.33	15.	0.18744515E	05	0.78457226E	-03
71.65	-10.18	15.	0.18744515E	05	0.78457226E	-03
71.90	-10.03	15.	0.18744515E	05	0.78457226E	-03
72.15	-9.88	15.	0.18744515E	05	0.78457226E	-03
72.40	-9.73	15.	0.18744515E	05	0.78457226E	-03
72.65	-9.58	15.	0.18744515E	05	0.78457226E	-03
72.90	-9.43	15.	0.18744515E	05	0.78457226E	-03
73.15	-9.28	15.	0.18744515E	05	0.78457226E	-03
73.40	-9.13	15.	0.18744515E	05	0.78457226E	-03
73.65	-8.98	15.	0.18744515E	05	0.78457226E	-03
73.90	-8.83	15.	0.18744515E	05	0.78457226E	-03
74.15	-8.68	15.	0.18744515E	05	0.78457226E	-03
74.40	-8.53	15.	0.18744515E	05	0.78457226E	-03
74.65	-8.38	15.	0.18744515E	05	0.78457226E	-03
74.90	-8.23	15.	0.18744515E	05	0.78457226E	-03
75.15	-8.08	15.	0.18744515E	05	0.78457226E	-03
75.40	-7.93	15.	0.18744515E	05	0.78457226E	-03
75.65	-7.78	15.	0.18744515E	05	0.78457226E	-03
75.90	-7.63	15.	0.18744515E	05	0.78457226E	-03
76.15	-7.48	15.	0.18744515E	05	0.78457226E	-03
76.40	-7.33	15.	0.18744515E	05	0.78457226E	-03
76.65	-7.18	15.	0.18744515E	05	0.78457226E	-03
76.90	-7.03	15.	0.18744515E	05	0.78457226E	-03
77.15	-6.88	15.	0.18744515E	05	0.78457226E	-03
77.40	-6.73	15.	0.18744515E	05	0.78457226E	-03
77.65	-6.58	15.	0.18744515E	05	0.78457226E	-03
77.90	-6.43	15.	0.18744515E	05	0.78457226E	-03
78.15	-6.28	15.	0.18744515E	05	0.78457226E	-03
78.40	-6.13	15.	0.18744515E	05	0.78457226E	-03
78.65	-5.98	15.	0.18744515E	05	0.78457226E	-03
78.90	-5.83	15.	0.18744515E	05	0.78457226E	-03
79.15	-5.68	15.	0.18744515E	05	0.78457226E	-03
79.40	-5.53	15.	0.18744515E	05	0.78457226E	-03
79.65	-5.38	15.	0.18744515E	05	0.78457226E	-03
79.90	-5.23	15.	0.18744515E	05	0.78457226E	-03
80.15	-5.08	15.	0.18744515E	05	0.78457226E	-03
80.40	-4.93	15.	0.18744515E	05	0.78457226E	-03
80.65	-4.78	15.	0.18744515E	05	0.78457226E	-03
80.90	-4.63	15.	0.18744515E	05	0.78457226E	-03
81.15	-4.48	15.	0.18744515E	05	0.78457226E	-03
81.40	-4.33	15.	0.18744515E	05	0.78457226E	-03
81.65	-4.18	15.	0.18744515E	05	0.78457226E	-03
81.90	-4.03	15.	0.18744515E	05	0.78457226E	-03
82.15	-3.88	15.	0.18744515E	05	0.78457226E	-03
82.40	-3.73	15.	0.18744515E	05	0.78457226E	-03
82.65	-3.58	15.	0.18744515E	05	0.78457226E	-03
82.90	-3.43	15.	0.18744515E	05	0.78457226E	-03
83.15	-3.28	15.	0.18744515E	05	0.78457226E	-03
83.40	-3.13	15.	0.18744515E	05	0.78457226E	-03
83.65	-2.98	15.	0.18744515E	05	0.78457226E	-03
83.90	-2.83	15.	0.18744515E	05	0.78457226E	-03
84.15	-2.68	15.	0.18744515E	05	0.78457226E	-03
84.40	-2.53	15.	0.18744515E	05	0.78457226E	-03
84.65	-2.38	15.	0.18744515E	05	0.78457226E	-03
84.90	-2.23	15.	0.18744515E	05	0.78457226E	-03
85.15	-2.08	15.	0.18744515E	05	0.78457226E	-03
85.40	-1.93	15.	0.18744515E	05	0.78457226E	-03
85.65	-1.78	15.	0.18744515E	05	0.78457226E	-03
85.90	-1.63	15.	0.18744515E	05	0.78457226E	-03
86.15	-1.48	15.	0.18744515E	05	0.78457226E	-03
86.40	-1.33	15.	0.18744515E	05	0.78457226E	-03
86.65	-1.18	15.	0.18744515E	05	0.78457226E	-03
86.90	-1.03	15.	0.18744515E	05	0.78457226E	-03
87.15	-0.88	15.	0.18744515E	05	0.78457226E	-03
87.40	-0.73	15.	0.18744515E	05	0.78457226E	-03
87.65	-0.58	15.	0.18744515E	05	0.78457226E	-03
87.90	-0.43	15.	0.18744515E	05	0.78457226E	-03
88.15	-0.28	15.	0.18744515E	05	0.78457226E	-03
88.40	-0.13	15.	0.18744515E	05	0.78457226E	-03
88.65	0.02	15.	0.18744515E	05	0.78457226E	-03
88.90	0.17	15.	0.18744515E	05	0.78457226E	-03
89.15	0.32	15.	0.18744515E	05	0.78457226E	-03
89.40	0.47	15.	0.18744515E	05	0.78457226E	-03
89.65	0.62	15.	0.18744515E	05	0.78457226E	-03
89.90	0.77	15.	0.18744515E	05	0.78457226E	-03
90.15	0.92	15.	0.18744515E	05	0.78457226E	-03
90.40	1.07	15.	0.18744515E	05	0.78457226E	-03
90.65	1.22	15.	0.18744515E	05	0.78457226E	-03
90.90	1.37	15.	0.18744515E	05	0.78457226E	-03
91.15	1.52	15.	0.18744515E	05	0.78457226E	-03
91.40	1.67	15.	0.18744515E	05	0.78457226E	-03
91.65	1.82	15.	0.18744515E	05	0.78457226E	-03
91.90	1.97	15.	0.18744515E			



50.62	136.	0.97	05	0.13	02
55.12	136.	0.86	05	0.15	02
55.71	136.	0.77	05	0.17	02
55.85	136.	0.63	05	0.19	02
55.90	136.	0.63	05	0.21	02
55.97	136.	0.57	05	0.23	02
55.87	136.	0.49	05	0.25	02
55.57	136.	0.45	05	0.27	02
55.37	250.	0.40	06	0.29	02
55.34	250.	0.20	06	0.31	02
55.20	250.	0.18	06	0.33	02
55.29	250.	0.16	06	0.35	02
55.62	250.	0.15	06	0.37	02
55.95	250.	0.14	06	0.39	02
55.22	250.	0.13	06	0.41	02
55.74	250.	0.12	06	0.43	02
55.67	250.	0.11	06	0.45	02
55.21	250.	0.11	06	0.47	02
55.98	4500.	0.11	06	0.49	02
55.77	6500.	0.08	07	0.51	03
55.09	9500.	0.77	09	0.52	02
55.39	17000.	0.20	10	0.53	02
28.36		0.47		0.55	04
		0.77		0.57	05
		0.20		0.59	
		0.00		0.61	
		0.00		0.63	
		0.00		0.65	
		0.00		0.67	
		0.00		0.69	
		0.00		0.71	
		0.00		0.73	
		0.00		0.75	
		0.00		0.77	
		0.00		0.79	
		0.00		0.81	
		0.00		0.83	
		0.00		0.85	
		0.00		0.87	
		0.00		0.89	
		0.00		0.91	
		0.00		0.93	
		0.00		0.95	
		0.00		0.97	
		0.00		0.99	
		0.00		1.01	
		0.00		1.03	
		0.00		1.05	
		0.00		1.07	
		0.00		1.09	
		0.00		1.11	
		0.00		1.13	
		0.00		1.15	
		0.00		1.17	
		0.00		1.19	
		0.00		1.21	
		0.00		1.23	
		0.00		1.25	
		0.00		1.27	
		0.00		1.29	
		0.00		1.31	
		0.00		1.33	
		0.00		1.35	
		0.00		1.37	
		0.00		1.39	
		0.00		1.41	
		0.00		1.43	
		0.00		1.45	
		0.00		1.47	
		0.00		1.49	
		0.00		1.51	
		0.00		1.53	
		0.00		1.55	
		0.00		1.57	
		0.00		1.59	
		0.00		1.61	
		0.00		1.63	
		0.00		1.65	
		0.00		1.67	
		0.00		1.69	
		0.00		1.71	
		0.00		1.73	
		0.00		1.75	
		0.00		1.77	
		0.00		1.79	
		0.00		1.81	
		0.00		1.83	
		0.00		1.85	
		0.00		1.87	
		0.00		1.89	
		0.00		1.91	
		0.00		1.93	
		0.00		1.95	
		0.00		1.97	
		0.00		1.99	
		0.00		2.01	
		0.00		2.03	
		0.00		2.05	
		0.00		2.07	
		0.00		2.09	
		0.00		2.11	
		0.00		2.13	
		0.00		2.15	
		0.00		2.17	
		0.00		2.19	
		0.00		2.21	
		0.00		2.23	
		0.00		2.25	
		0.00		2.27	
		0.00		2.29	
		0.00		2.31	
		0.00		2.33	
		0.00		2.35	
		0.00		2.37	
		0.00		2.39	
		0.00		2.41	
		0.00		2.43	
		0.00		2.45	
		0.00		2.47	
		0.00		2.49	
		0.00		2.51	
		0.00		2.53	
		0.00		2.55	
		0.00		2.57	
		0.00		2.59	
		0.00		2.61	
		0.00		2.63	
		0.00		2.65	
		0.00		2.67	
		0.00		2.69	
		0.00		2.71	
		0.00		2.73	
		0.00		2.75	
		0.00		2.77	
		0.00		2.79	
		0.00		2.81	
		0.00		2.83	
		0.00		2.85	
		0.00		2.87	
		0.00		2.89	
		0.00		2.91	
		0.00		2.93	
		0.00		2.95	
		0.00		2.97	
		0.00		2.99	
		0.00		3.01	
		0.00		3.03	
		0.00		3.05	
		0.00		3.07	
		0.00		3.09	
		0.00		3.11	
		0.00		3.13	
		0.00		3.15	
		0.00		3.17	
		0.00		3.19	
		0.00		3.21	
		0.00		3.23	
		0.00		3.25	
		0.00		3.27	
		0.00		3.29	
		0.00		3.31	
		0.00		3.33	
		0.00		3.35	
		0.00		3.37	
		0.00		3.39	
		0.00		3.41	
		0.00		3.43	
		0.00		3.45	
		0.00		3.47	
		0.00		3.49	
		0.00		3.51	
		0.00		3.53	
		0.00		3.55	
		0.00		3.57	
		0.00		3.59	
		0.00		3.61	
		0.00		3.63	
		0.00		3.65	
		0.00		3.67	
		0.00		3.69	
		0.00		3.71	
		0.00		3.73	
		0.00		3.75	
		0.00		3.77	
		0.00		3.79	
		0.00		3.81	
		0.00		3.83	
		0.00		3.85	
		0.00		3.87	
		0.00		3.89	
		0.00		3.91	
		0.00		3.93	
		0.00		3.95	
		0.00		3.97	
		0.00		3.99	
		0.00		4.01	
		0.00		4.03	
		0.00		4.05	
		0.00		4.07	
		0.00		4.09	
		0.00		4.11	
		0.00		4.13	
		0.00		4.15	
		0.00		4.17	
		0.00		4.19	
		0.00		4.21	
		0.00		4.23	
		0.00		4.25	
		0.00		4.27	
		0.00		4.29	
		0.00		4.31	
		0.00		4.33	
		0.00		4.35	
		0.00		4.37	
		0.00		4.39	
		0.00		4.41	
		0.00		4.43	
		0.00		4.45	
		0.00		4.47	
		0.00		4.49	
		0.00		4.51	
		0.00		4.53	
		0.00		4.55	
		0.00		4.57	
		0.00		4.59	
		0.00		4.61	
		0.00		4.63	
		0.00		4.65	
		0.00		4.67	
		0.00		4.69	
		0.00		4.71	
		0.00		4.73	
		0.00		4.75	
		0.00		4.77	
		0.00		4.79	
		0.00		4.81	
		0.00		4.83	
		0.00		4.85	
		0.00		4.87	
		0.00		4.89	
		0.00		4.91	
		0.00		4.93	
		0.00		4.95	
		0.00		4.97	
		0.00		4.99	
		0.00		5.01	
		0.00		5.03	
		0.00		5.05	
		0.00		5.07	
		0.00		5.09	
		0.00		5.11	
		0.00		5.13	
		0.00		5.15	
		0.00		5.17	
		0.00		5.19	
		0.00		5.21	
		0.00		5.23	
		0.00		5.25	
		0.00		5.27	
		0.00		5.29	
		0.00		5.31	
		0.00		5.33	
		0.00		5.35	
		0.00		5.37	
		0.00		5.39	
		0.00		5.41	
		0.00		5.43	
		0.00		5.45	
		0.00		5.47	
		0.00		5.49	
		0.00		5.51	
		0.00		5.53	
		0.00		5.55	
		0.00		5.57	
		0.00		5.59	
		0.00		5.61	
		0.00		5.63	
		0.00		5.65	
		0.00		5.67	
		0.00		5.69	
		0.00		5.71	
		0.00		5.73	
		0.00		5.75	
		0.00		5.77	
		0.00		5.79	
		0.00		5.81	
		0.00		5.83	
		0.00		5.85	
		0.00		5.87	
		0.00		5.89	
		0.00		5.91	
		0.00		5.93	
		0.00		5.95	
		0.00		5.97	
		0.00		5.99	
		0.00		6.01	
		0.00		6.03	
		0.00		6.05	
		0.00		6.07	
		0.00		6.09	
		0.00		6.11	
		0.00		6.13	
		0.00		6.15	
		0.00		6.17	
		0.00		6.19	
		0.00		6.21	
		0.00		6.23	

# INPUT CF BLOCK LCADS

<p>A7 CRITICAL<sup>1</sup> PCINT #1 FROM U166808</p>		<p>C.4</p>		<p>-1.836</p>		<p>10000.</p>	
7075-16 AL	72.801	71.7MIL-HDBK-5A	4	7075	5	7075	6
	.5154	56.3MIL-HDBK-5A	5	7075	6	7075	7
	.6141	44.6MIL-HDBK-5A	6	7075	7	7075	8
	.6838	38.1MIL-HDBK-5A	7	7075	8	7075	9
	1.	1.	8	7075	9	7075	10
			9	7075	10	7075	11
			10	7075	11	7075	12
			11	7075	12	7075	13
			12	7075	13	7075	14
			13	7075	14	7075	15
			14	7075	15	7075	16
			15	7075	16	7075	17
			16	7075	17	7075	18
			17	7075	18	7075	19
			18	7075	19	7075	20
			19	7075	20	7075	21
			20	7075	21	7075	22
			21	7075	22	7075	23
			22	7075	23	7075	24
			23	7075	24	7075	25
			24	7075	25	7075	26
			25	7075	26	7075	27
			26	7075	27	7075	28
			27	7075	28	7075	29
			28	7075	29	7075	30
			29	7075	30	7075	31
			30	7075	31	7075	32
			31	7075	32	7075	33
			32	7075	33	7075	34
			33	7075	34	7075	35
			34	7075	35	7075	36
			35	7075	36	7075	37
			36	7075	37	7075	38
			37	7075	38	7075	39
			38	7075	39	7075	40
			39	7075	40	7075	41
			40	7075	41	7075	42
			41	7075	42	7075	43
			42	7075	43	7075	44
			43	7075	44	7075	45
			44	7075	45	7075	46
			45	7075	46	7075	47
			46	7075	47	7075	48
			47	7075	48	7075	49
			48	7075	49	7075	50
			49	7075	50	7075	51
			50	7075	51	7075	52
			51	7075	52	7075	53
			52	7075	53	7075	54
			53	7075	54	7075	55
			54	7075	55	7075	56
			55	7075	56	7075	57
			56	7075	57	7075	58
			57	7075	58	7075	59
			58	7075	59	7075	60
			59	7075	60	7075	61
			60	7075	61	7075	62
			61	7075	62	7075	63
			62	7075	63	7075	64
			63	7075	64	7075	65
			64	7075	65	7075	66
			65	7075	66	7075	67
			66	7075	67	7075	68
			67	7075	68	7075	69
			68	7075	69	7075	70
			69	7075	70	7075	71
			70	7075	71	7075	72
			71	7075	72	7075	73
			72	7075	73	7075	74
			73	7075	74	7075	75
			74	7075	75	7075	76
			75	7075	76	7075	77
			76	7075	77	7075	78
			77	7075	78	7075	79
			78	7075	79	7075	80
			79	7075	80	7075	81
			80	7075	81	7075	82
			81	7075	82	7075	83
			82	7075	83	7075	84
			83	7075	84	7075	85
			84	7075	85	7075	86
			85	7075	86	7075	87
			86	7075	87	7075	88
			87	7075	88	7075	89
			88	7075	89	7075	90
			89	7075	90	7075	91
			90	7075	91	7075	92
			91	7075	92	7075	93
			92	7075	93	7075	94
			93	7075	94	7075	95
			94	7075	95	7075	96
			95	7075	96	7075	97
			96	7075	97	7075	98
			97	7075	98	7075	99
			98	7075	99	7075	100
			99	7075	100	7075	101
			100	7075	101	7075	102
			101	7075	102	7075	103
			102	7075	103	7075	104
			103	7075	104	7075	105
			104	7075	105	7075	106
			105	7075	106	7075	107
			106	7075	107	7075	108
			107	7075	108	7075	109
			108	7075	109	7075	110
			109	7075	110	7075	111
			110	7075	111	7075	112
			111	7075	112	7075	113
			112	7075	113	7075	114
			113	7075	114	7075	115
			114	7075	115	7075	116
			115	7075	116	7075	117
			116	7075	117	7075	118
			117	7075	118	7075	119
			118	7075	119	7075	120
			119	7075	120	7075	121
			120	7075	121	7075	122
			121	7075	122	7075	123
			122	7075	123	7075	124
			123	7075	124	7075	125
			124	7075	125	7075	126
			125	7075	126	7075	127
			126	7075	127	7075	128
			127	7075	128	7075	129
			128	7075	129	7075	130
			129	7075	130	7075	131
			130	7075	131	7075	132
			131	7075	132	7075	133
			132	7075	133	7075	134
			133	7075	134	7075	135
			134	7075	135	7075	136
			135	7075	136	7075	137
			136	7075	137	7075	138
			137	7075	138	7075	139
			138	7075	139	7075	140
			139	7075	140	7075	141
			140	7075	141	7075	142
			141	7075	142	7075	143
			142	7075	143	7075	144
			143	7075	144	7075	145
			144	7075	145	7075	146
			145	7075	146	7075	147
			146	7075	147	7075	148
			147	7075	148	7075	149
			148	7075	149	7075	150
			149	7075	150	7075	151
			150	7075	151	7075	152
			151	7075	152	7075	153
			152	7075	153	7075	154
			153	7075	154	7075	155
			154	7075	155	7075	156
			155	7075	156	7075	157
			156	7075	157	7075	158
			157	7075	158	7075	159
			158	7075	159	7075	160
			159	7075	160	7075	161
			160	7075	161	7075	162
			161	7075	162	7075	163
			162	7075	163	7075	164
			163	7075	164	7075	165
			164	7075	165	7075	166
			165	7075	166	7075	167
			166	7075	167	7075	168
			167	7075	168	7075	169
			168	7075	169	7075	170
			169	7075	170	7075	171
			170	7075	171	7075	172
			171	7075	172	7075	173
			172	7075	173	7075	174
			173	7075	174	7075	175
			174	7075	175	7075	176
			175	7075	176	7075	177
			176	7075	177	7075	178
			177	7075	178	7075	179
			178	7075	179	7075	180
			179	7075	180	7075	181
			180	7075	181	7075	182
			181	7075	182	7075	183
			182	7075	183	7075	184
			183	7075	184	7075	

OUTPUT OF BLOCK LOADS, IPRINT = 2

1 DATA DECKS ARE TO BE PROCESSED.  
SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION





1 10 9 8 7 6 5 4 3 2 1  
2 1 2 3 4 5 6 7 8 9 10

SPECTRUM FROM A7 CRITICAL POINT #1 FROM U166808

AKT = 2.72

RELAXATION CONSTANT C1= 10000000.00

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE

FLIGHT CR BLOCK NO.	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP		
37.25	72.00	-20.40	0.0	-29.32	16.00	0.17906543E 04	1	1
37.27	63.89	-20.39	-29.32	-21.21	40.00	0.21008384E 04	2	2
RELAXATION	63.91	-20.35			4.00			
RELAXATION	63.95	-20.32			4.00			
RELAXATION	63.98	-20.32			4.00			
RELAXATION	64.02	-20.25			4.00			
RELAXATION	64.05	-20.21			4.00			
RELAXATION	64.09	-20.18			4.00			
RELAXATION	64.12	-20.14			4.00			
RELAXATION	64.16	-20.11			4.00			
RELAXATION	64.19	-20.07			4.00			
RELAXATION	64.23	-20.06	-28.97	-13.11	150.00	C.24992734E 04	3	12
RELAXATION	56.14	-19.95			15.00			
RELAXATION	56.25	-19.73			15.00			
RELAXATION	56.46	-19.52			15.00			
RELAXATION	56.67	-19.31			15.00			
RELAXATION	56.89	-19.10			15.00			
RELAXATION	57.09	-18.90			15.00			
RELAXATION	57.30	-18.69			15.00			
RELAXATION	57.50	-18.49			15.00			
RELAXATION	57.70	-18.30			15.00			
RELAXATION	57.89	-18.10			15.00			
RELAXATION	58.09	-17.91	-26.92	-5.00	44.00	0.30229507E 04	4	22
RELAXATION	50.08	-17.65			44.00			
RELAXATION	50.44	-17.44			44.00			
RELAXATION	51.15	-16.94			44.00			
RELAXATION	51.84	-16.25			44.00			
RELAXATION	52.50	-15.58			44.00			
RELAXATION	53.15	-14.94			44.00			
RELAXATION	53.77	-14.32			44.00			
RELAXATION	54.37	-13.72			44.00			
RELAXATION	54.95	-13.14			44.00			
RELAXATION	55.51	-12.58			44.00			
RELAXATION	56.06	-12.03			44.00			
RELAXATION	56.62	-11.48	-20.68	0.0	44.00	0.37305303E 04	5	32
RELAXATION	48.22	-10.93			44.00			
RELAXATION	49.05	-10.26			44.00			
RELAXATION	50.65	-9.53			44.00			
RELAXATION	51.22	-8.76			44.00			
RELAXATION	51.77	-7.93			44.00			
RELAXATION	52.33	-7.06			44.00			
RELAXATION	52.88	-6.13			44.00			
RELAXATION	53.44	-5.15			44.00			
RELAXATION	54.00	-4.12			44.00			
RELAXATION	54.56	-3.06			44.00			
RELAXATION	55.12	-1.93			44.00			
RELAXATION	55.68	-0.76			44.00			
RELAXATION	56.24	0.41			44.00			
RELAXATION	56.80	1.58			44.00			
RELAXATION	57.36	2.75			44.00			
RELAXATION	57.92	3.92			44.00			
RELAXATION	58.48	5.09			44.00			
RELAXATION	59.04	6.26			44.00			
RELAXATION	59.60	7.43			44.00			
RELAXATION	60.16	8.60			44.00			
RELAXATION	60.72	9.77			44.00			
RELAXATION	61.28	10.94			44.00			
RELAXATION	61.84	12.11			44.00			
RELAXATION	62.40	13.28			44.00			
RELAXATION	62.96	14.45			44.00			
RELAXATION	63.52	15.62			44.00			
RELAXATION	64.08	16.79			44.00			
RELAXATION	64.64	17.96			44.00			
RELAXATION	65.20	19.13			44.00			
RELAXATION	65.76	20.30			44.00			
RELAXATION	66.32	21.47			44.00			
RELAXATION	66.88	22.64			44.00			
RELAXATION	67.44	23.81			44.00			
RELAXATION	68.00	24.98			44.00			
RELAXATION	68.56	26.15			44.00			
RELAXATION	69.12	27.32			44.00			
RELAXATION	69.68	28.49			44.00			
RELAXATION	70.24	29.66			44.00			
RELAXATION	70.80	30.83			44.00			
RELAXATION	71.36	32.00			44.00			
RELAXATION	71.92	33.17			44.00			
RELAXATION	72.48	34.34			44.00			
RELAXATION	73.04	35.51			44.00			
RELAXATION	73.60	36.68			44.00			
RELAXATION	74.16	37.85			44.00			
RELAXATION	74.72	39.02			44.00			
RELAXATION	75.28	40.19			44.00			
RELAXATION	75.84	41.36			44.00			
RELAXATION	76.40	42.53			44.00			
RELAXATION	76.96	43.70			44.00			
RELAXATION	77.52	44.87			44.00			
RELAXATION	78.08	46.04			44.00			
RELAXATION	78.64	47.21			44.00			
RELAXATION	79.20	48.38			44.00			
RELAXATION	79.76	49.55			44.00			
RELAXATION	80.32	50.72			44.00			
RELAXATION	80.88	51.89			44.00			
RELAXATION	81.44	53.06			44.00			
RELAXATION	82.00	54.23			44.00			
RELAXATION	82.56	55.40			44.00			
RELAXATION	83.12	56.57			44.00			
RELAXATION	83.68	57.74			44.00			
RELAXATION	84.24	58.91			44.00			
RELAXATION	84.80	60.08			44.00			
RELAXATION	85.36	61.25			44.00			
RELAXATION	85.92	62.42			44.00			
RELAXATION	86.48	63.59			44.00			
RELAXATION	87.04	64.76			44.00			
RELAXATION	87.60	65.93			44.00			
RELAXATION	88.16	67.10			44.00			
RELAXATION	88.72	68.27			44.00			
RELAXATION	89.28	69.44			44.00			
RELAXATION	89.84	70.61			44.00			
RELAXATION	90.40	71.78			44.00			
RELAXATION	90.96	72.95			44.00			
RELAXATION	91.52	74.12			44.00			
RELAXATION	92.08	75.29			44.00			
RELAXATION	92.64	76.46			44.00			
RELAXATION	93.20	77.63			44.00			
RELAXATION	93.76	78.80			44.00			
RELAXATION	94.32	79.97			44.00			
RELAXATION	94.88	81.14			44.00			
RELAXATION	95.44	82.31			44.00			
RELAXATION	96.00	83.48			44.00			
RELAXATION	96.56	84.65			44.00			
RELAXATION	97.12	85.82			44.00			
RELAXATION	97.68	86.99			44.00			
RELAXATION	98.24	88.16			44.00			
RELAXATION	98.80	89.33			44.00			
RELAXATION	99.36	90.50			44.00			
RELAXATION	99.92	91.67			44.00			
RELAXATION	100.48	92.84			44.00			
RELAXATION	101.04	94.01			44.00			
RELAXATION	101.60	95.18			44.00			
RELAXATION	102.16	96.35			44.00			
RELAXATION	102.72	97.52			44.00			
RELAXATION	103.28	98.69			44.00			
RELAXATION	103.84	99.86			44.00			
RELAXATION	104.40	101.03			44.00			
RELAXATION	104.96	102.20			44.00			
RELAXATION	105.52	103.37			44.00			
RELAXATION	106.08	104.54			44.00			
RELAXATION	106.64	105.71			44.00			
RELAXATION	107.20	106.88			44.00			
RELAXATION	107.76	108.05			44.00			
RELAXATION	108.32	109.22			44.00			
RELAXATION	108.88	110.39			44.00			
RELAXATION	109.44	111.56			44.00			
RELAXATION	109.99	112.73			44.00			
RELAXATION	110.55	113.90			44.00			
RELAXATION	111.11	115.07			44.00			
RELAXATION	111.67	116.24			44.00			
RELAXATION	112.23	117.41			44.00			
RELAXATION	112.79	118.58			44.00			
RELAXATION	113.35	119.75			44.00			
RELAXATION	113.91	120.92			44.00			
RELAXATION	114.47	122.09			44.00			
RELAXATION	115.03	123.26			44.00			
RELAXATION	115.59	124.43			44.00			
RELAXATION	116.15	125.60			44.00			
RELAXATION	116.71	126.77			44.00			
RELAXATION	117.27	127.94			44.00			
RELAXATION	117.83	129.11			44.00			
RELAXATION	118.39	130.28			44.00			
RELAXATION	118.95	131.45			44.00			
RELAXATION	119.51	132.62			44.00			
RELAXATION	120.07	133.79			44.00			
RELAXATION	120.63	134.96			44.00			
RELAXATION	121.19	136.13			44.00			
RELAXATION	121.75	137.30			44.00			
RELAXATION	122.31	138.47			44.00			
RELAXATION	122.87	139.64			44.00			
RELAXATION	123.43	140.81			44.00			
RELAXATION	123.99	141.98			44.00			
RELAXATION	124.55	143.15			44.00			
RELAXATION	125.11	144.32			44.00			
RELAXATION	125.67	145.49			44.00			
RELAXATION	126.23	146.66			44.00			
RELAXATION	126.79	147.83			44.00			
RELAXATION	127.35	149.00			44.00			
RELAXATION	127.91	150.17			44.00			
RELAXATION	128.47	151.34			44.00			
RELAXATION	129.03	152.51			44.00			
RELAXATION	129.59	153.68			44.00			
RELAXATION	130.15	154.85			44.00			
RELAXATION	130.71	156.02			44.00			
RELAXATION	131.27	157.19			44.00			
RELAXATION	131.83	158.36			44.00			
RELAXATION	132.39	159.53			44.00			
RELAXATION	132.95	160.70			44.00			
RELAXATION	133.51	161.87			44.00			
RELAXATION	134.07	163.04			44.00			
RELAXATION	134.63	164.21			44.00			
RELAXATION	135.19	165.38			44.00			
RELAXATION	135.75	166.55			44.00			
RELAXATION	136.31	167.72			44.00			
RELAXATION								















1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	1																																																																																								



OUTPLT CF BLOCK LOADS, IPRINT = 2

1 DATA DECKS ARE TO BE PROCESSED.  
NO COUNTING METHODS USED  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION

SPECTRUM FROM A7 CRITICAL POINT #1 FROM U166808  
MATERIAL TYPE -- 7075-T6 AL

TENSILE YIELD STRESS (KSI) -- 72.00000

LCF STRAIN INTERCEPT = 0.40000

INVERSE CF COFFIN-MANSON SLOPE -1.83600

ELASTIC MODULUS = 10000.00000

COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DATA

SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I)	
LIFE	C(I)
1C**4	71.70000
10**5	56.29599
1C**6	44.59599
1C**7	38.09599

UNNOTCHED COUPON S-N DATA DERIVED FROM  
INFORMATION SUPPLIED FROM MIL-HDBK-5A

RESIDUAL STRESS RELAXATION FUNCTION

ENEP = C1/(KTSMAX\*\*E1 \* KTSMEAN\*\*E2)

WHERE C1 = C.10000000E 08 , E1 = 1.000 AND E2 = 1.000

2 TIMES THROUGH BLOCK OF 10 LOADS

LCAC LIMIT = 29.79999

STEP	TYPE	STMIN	STMAX	ENN
1	1	0.11000	1.25000	16.00000
2	2	0.11000	1.15000	40.00000
3	3	0.11000	1.05000	150.00000
4	4	0.11000	0.95000	440.00000
5	5	0.11000	0.85000	1360.00000
6	6	0.11000	0.75000	2500.00000
7	7	0.11000	0.65000	4500.00000
8	8	0.11000	0.55000	6500.00000
9	9	0.11000	0.45000	9500.00000
10	10	0.11000	0.35000	17000.00000

BLOCK TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE

1 2 10 9 8 7 6 5 4 3 2 1  
2 10 9 8 7 6 5 4 3 2 10



SPECTRUM FROM A7 CRITICAL POINT #1 FROM U1668C8

AKT = 2.72

RELAXATION CONSTANT C1=1	FLIGHT CR BLOCK NO.	SIGMIN	RES	EQRES	ENH	NEP			
37.25	3.28	72.00	0.0	-29.32	16.00	0.17906543E C4	1	1	2
34.27	3.28	63.89	-29.32	-21.21	4.00	0.21008384E C4	2	2	
RELAXATION		63.91			4.00				
RELAXATION		63.95			4.00				
RELAXATION		63.98			4.00				
RELAXATION		64.02			4.00				
RELAXATION		64.05			4.00				
RELAXATION		64.09			4.00				
RELAXATION		64.12			4.00				
RELAXATION		64.16			4.00				
RELAXATION		64.19			4.00				
RELAXATION		64.23			4.00				
RELAXATION		64.26			4.00				
RELAXATION		64.29			4.00				
RELAXATION		64.32			4.00				
RELAXATION		64.35			4.00				
RELAXATION		64.38			4.00				
RELAXATION		64.41			4.00				
RELAXATION		64.44			4.00				
RELAXATION		64.47			4.00				
RELAXATION		64.50			4.00				
RELAXATION		64.53			4.00				
RELAXATION		64.56			4.00				
RELAXATION		64.59			4.00				
RELAXATION		64.62			4.00				
RELAXATION		64.65			4.00				
RELAXATION		64.68			4.00				
RELAXATION		64.71			4.00				
RELAXATION		64.74			4.00				
RELAXATION		64.77			4.00				
RELAXATION		64.80			4.00				
RELAXATION		64.83			4.00				
RELAXATION		64.86			4.00				
RELAXATION		64.89			4.00				
RELAXATION		64.92			4.00				
RELAXATION		64.95			4.00				
RELAXATION		64.98			4.00				
RELAXATION		65.01			4.00				
RELAXATION		65.04			4.00				
RELAXATION		65.07			4.00				
RELAXATION		65.10			4.00				
RELAXATION		65.13			4.00				
RELAXATION		65.16			4.00				
RELAXATION		65.19			4.00				
RELAXATION		65.22			4.00				
RELAXATION		65.25			4.00				
RELAXATION		65.28			4.00				
RELAXATION		65.31			4.00				
RELAXATION		65.34			4.00				
RELAXATION		65.37			4.00				
RELAXATION		65.40			4.00				
RELAXATION		65.43			4.00				
RELAXATION		65.46			4.00				
RELAXATION		65.49			4.00				
RELAXATION		65.52			4.00				
RELAXATION		65.55			4.00				
RELAXATION		65.58			4.00				
RELAXATION		65.61			4.00				
RELAXATION		65.64			4.00				
RELAXATION		65.67			4.00				
RELAXATION		65.70			4.00				
RELAXATION		65.73			4.00				
RELAXATION		65.76			4.00				
RELAXATION		65.79			4.00				
RELAXATION		65.82			4.00				
RELAXATION		65.85			4.00				
RELAXATION		65.88			4.00				
RELAXATION		65.91			4.00				
RELAXATION		65.94			4.00				
RELAXATION		65.97			4.00				
RELAXATION		66.00			4.00				
RELAXATION		66.03			4.00				
RELAXATION		66.06			4.00				
RELAXATION		66.09			4.00				
RELAXATION		66.12			4.00				
RELAXATION		66.15			4.00				
RELAXATION		66.18			4.00				
RELAXATION		66.21			4.00				
RELAXATION		66.24			4.00				
RELAXATION		66.27			4.00				
RELAXATION		66.30			4.00				
RELAXATION		66.33			4.00				
RELAXATION		66.36			4.00				
RELAXATION		66.39			4.00				
RELAXATION		66.42			4.00				
RELAXATION		66.45			4.00				
RELAXATION		66.48			4.00				
RELAXATION		66.51			4.00				
RELAXATION		66.54			4.00				
RELAXATION		66.57			4.00				
RELAXATION		66.60			4.00				
RELAXATION		66.63			4.00				
RELAXATION		66.66			4.00				
RELAXATION		66.69			4.00				
RELAXATION		66.72			4.00				
RELAXATION		66.75			4.00				
RELAXATION		66.78			4.00				
RELAXATION		66.81			4.00				
RELAXATION		66.84			4.00				
RELAXATION		66.87			4.00				
RELAXATION		66.90			4.00				
RELAXATION		66.93			4.00				
RELAXATION		66.96			4.00				
RELAXATION		66.99			4.00				
RELAXATION		67.02			4.00				
RELAXATION		67.05			4.00				
RELAXATION		67.08			4.00				
RELAXATION		67.11			4.00				
RELAXATION		67.14			4.00				
RELAXATION		67.17			4.00				
RELAXATION		67.20			4.00				
RELAXATION		67.23			4.00				
RELAXATION		67.26			4.00				
RELAXATION		67.29			4.00				
RELAXATION		67.32			4.00				
RELAXATION		67.35			4.00				
RELAXATION		67.38			4.00				
RELAXATION		67.41			4.00				
RELAXATION		67.44			4.00				
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RELAXATION		67.50			4.00				
RELAXATION		67.53			4.00				
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RELAXATION		67.86			4.00				
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RELAXATION		67.95			4.00				
RELAXATION		67.98			4.00				
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RELAXATION		68.04			4.00				
RELAXATION		68.07			4.00				
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RELAXATION		68.13			4.00				
RELAXATION		68.16			4.00				
RELAXATION		68.19			4.00				
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RELAXATION		68.28			4.00				
RELAXATION		68.31			4.00				
RELAXATION		68.34			4.00				
RELAXATION		68.37			4.00				
RELAXATION		68.40			4.00				
RELAXATION		68.43			4.00				
RELAXATION		68.46			4.00				
RELAXATION		68.49			4.00				
RELAXATION		68.52			4.00				
RELAXATION		68.55			4.00				
RELAXATION		68.58			4.00				
RELAXATION		68.61			4.00				
RELAXATION		68.64			4.00				
RELAXATION		68.67			4.00				
RELAXATION		68.70			4.00				
RELAXATION		68.73			4.00				
RELAXATION		68.76			4.00				
RELAXATION		68.79			4.00				
RELAXATION		68.82			4.00				
RELAXATION		68.85			4.00				
RELAXATION		68.88			4.00				
RELAXATION		68.91			4.00				
RELAXATION		68.94			4.00				
RELAXATION		68.97			4.00				
RELAXATION		69.00			4.00				
RELAXATION		69.03			4.00				
RELAXATION		69.06			4.00				
RELAXATION		69.09			4.00				
RELAXATION		69.12			4.00				
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RELAXATION		69.24			4.00				
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RELAXATION		69.33			4.00				
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RELAXATION		69.39			4.00				
RELAXATION		69.42			4.00				
RELAXATION		69.45			4.00				
RELAXATION		69.48			4.00				
RELAXATION		69.51			4.00				
RELAXATION		69.54			4.00				
RELAXATION		69.57			4.00				
RELAXATION		69.60			4.00				
RELAXATION		69.63			4.00				
RELAXATION		69.66			4.00				
RELAXATION		69.69			4.00				
RELAXATION		69.72			4.00				
RELAXATION		69.75			4.00				
RELAXATION		69.78			4.00				
RELAXATION		69.81			4.00				
RELAXATION		69.84</							







RELAXAXATTICN	3.28	64.05	-20.25	-28.97	-13.11	15C.00	0.24992734E 04	3 12	56
RELAXAXATTICN		64.09	-20.21			4.00			7
RELAXAXATTICN		64.12	-20.18			4.00			8
RELAXAXATTICN		64.16	-20.14			4.00			9
RELAXAXATTICN		64.19	-20.11			4.00			10
RELAXAXATTICN		64.23	-20.07			4.00			11
RELAXAXATTICN	3.28	56.14	-20.06			15C.00	0.24992734E 04	3 12	12
RELAXAXATTICN		56.25	-19.73			11E.00			13
RELAXAXATTICN		56.47	-19.52			11E.00			14
RELAXAXATTICN		56.89	-19.31			11E.00			15
RELAXAXATTICN		57.30	-19.10			11E.00			16
RELAXAXATTICN		57.50	-18.90			11E.00			17
RELAXAXATTICN		57.70	-18.69			11E.00			18
RELAXAXATTICN		57.89	-18.49			11E.00			19
RELAXAXATTICN		58.08	-18.30			11E.00			20
RELAXAXATTICN	3.28	50.44	-18.01			44.00	0.30229507E 04	4 22	21
RELAXAXATTICN		50.45	-17.65			44.00			22
RELAXAXATTICN		51.15	-16.94			44.00			23
RELAXAXATTICN		51.84	-16.25			44.00			24
RELAXAXATTICN		52.50	-15.58			44.00			25
RELAXAXATTICN		53.15	-14.94			44.00			26
RELAXAXATTICN		53.77	-14.32			44.00			27
RELAXAXATTICN		54.37	-13.72			44.00			28
RELAXAXATTICN		54.95	-13.14			44.00			29
RELAXAXATTICN		55.51	-12.58			44.00			30
RELAXAXATTICN	3.28	56.06	-12.03			44.00	0.37305303E 04	5 32	31
RELAXAXATTICN		49.05	-11.93			**##**			32
RELAXAXATTICN		50.65	-10.93			136.00			33
RELAXAXATTICN		52.12	-9.86			136.00			34
RELAXAXATTICN		53.71	-6.27			136.00			35
RELAXAXATTICN		54.85	-5.13			136.00			36
RELAXAXATTICN		55.90	-4.08			136.00			37
RELAXAXATTICN		56.87	-3.08			136.00			38
RELAXAXATTICN		57.76	-2.11			136.00			39
RELAXAXATTICN		58.57	-1.22			136.00			40
RELAXAXATTICN	3.28	59.35	-0.41			**##**	0.47195547E 04	6 42	41
RELAXAXATTICN		51.86	-0.02			**##**			42
RELAXAXATTICN		52.34	0.50			25C.00			43
RELAXAXATTICN		53.37	1.33			25C.00			44
RELAXAXATTICN		54.20	2.08			25C.00			45
RELAXAXATTICN		54.95	3.34			25C.00			46
RELAXAXATTICN		55.62	4.48			25C.00			47
RELAXAXATTICN		56.74	5.37			25C.00			48

RELAXATION	57.21	5.33	25C.00	0.0	0.61621797E	04	7	52
RELAXATION	57.62	5.74	25C.00	0.0	0.83860000E	C4	8	53
RELAXATION	57.98	6.11	25C.00	0.0	0.12079809E	C5	9	54
RELAXATION	50.05	6.28	*****	0.0	0.18907535E	C5	10	55
RELAXATION	44.09	8.43	*****	0.0				
RELAXATION	36.39	8.83	*****	0.0				
RELAXATION	28.36	8.90	*****	0.0				

LOCAL STRESSES AND PLASTIC STRAINS WITH RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	DAMAGE FROM PLASTIC STRAINS	MAX CR MIN	DAMAGE
1	0.00706	0.603239E-03		0.603239E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENR/CYC	DAMAGE
72.00	-20.40	16.	9959805E	0.16000031E	02
63.91	-20.39	4.	0.105511C9E	0.36393036E	03
63.95	-20.35	4.	0.109571137E	0.36455530CE	03
64.02	-20.28	4.	0.109538156E	0.36525565E	03
64.09	-20.25	4.	0.109319895E	0.36569219E	03
64.12	-20.21	4.	0.10917375E	0.36551784E	03
64.16	-20.18	4.	0.10897375E	0.36630387E	03
64.19	-20.14	4.	0.108866233E	0.36706077E	03
64.23	-20.11	4.	0.10866633E	0.36742747E	03
66.25	-20.09	15.	0.20582109E	0.36811C94E	03
66.46	-19.95	15.	0.20555750E	0.368788C9E	03
66.89	-19.73	15.	0.20133533E	0.73685557E	03
67.30	-19.52	15.	0.19922333E	0.75228866E	03
67.50	-19.31	15.	0.19717248E	0.76075383E	03
67.70	-18.69	15.	0.19511868E	0.76873833E	03
67.89	-18.49	15.	0.19118684E	0.77664338E	03
68.44	-18.30	15.	0.18933027E	0.78455226E	03
68.45	-18.10	44.	0.48277448E	0.80020655E	03
68.45	-17.65	44.	0.44130517E	0.91145544E	03
68.45	-16.94	44.	0.42277648E	0.95382221E	03
68.45	-16.58	44.	0.42277648E	0.95655233E	02
68.45	-15.94	44.	0.38933032E	0.10400735E	02
68.45	-14.72	44.	0.37430322E	0.11300114E	02
68.45	-13.14	44.	0.36022719E	0.11755033E	02
68.45	-12.58	44.	0.34707328E	0.12214326E	02
68.45	-12.03	44.	0.33333333E	0.12677481E	02
68.45	-10.93	136.	0.11033333E	0.13144481E	02





# INPUT CF RANCU GENERATED LOADS

```

1 1
A7 CRITICAL PCINT #1 FRGM UI66808
7075-16 AL
- .0020
- .0022
- .0014
- .0013
10000000.
1 2.72 4201 1
1 29.8
1 1

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C.4
71.7 MIL-HCBK-5A 10000.
56.3 MIL-HCBK-5A 7075
44.6 MIL-HCBK-5A 7075
38.1 MIL-HCBK-5A 7075
1.
-1.836
4 7075
5 7075
6 7075
7 7075

```

OUTPLT CF 4201 RANDU GENERATED LOADS, IPRINT = 3

1 DATA DECKS ARE TO BE PROCESSED.

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION

SPECTRUM FRM A7 CRITICAL PCINT #1 FRM U166808  
MATERIAL TYPE -- 7075-T6 AL

TENSILE YIELD STRESS (KSI) -- 72.00000

LCF STRAIN INTERCEPT = 0.40000

INVERSE CF COFFIN-MANSON SLOPE -1.83600

ELASTIC MODULUS = 10000.00000

COEFFICIENTS CF SECOND ORDER LEAST SQUARE FIT OF S-N DATA

LIFE	A(I)	B(I)	C(I)
1C**4	-0.00200	0.28010	71.70000
1C**5	-0.00220	0.51540	56.29999
1C**6	-0.00140	0.61410	44.59999
1C**7	-0.00130	0.68380	38.09999

UNNOTCHED COUPON S-N DATA DERIVED FROM  
INFORMATION SUPPLIED FROM MIL-HDBK-5A

RESIDUAL STRESS RELAXATION FUNCTION

ENEP = C1/(KTSMAX\*\*E1 \* KTSMEAN\*\*E2)  
WHERE C1 = 0.10000000E 08, E1 = 1.000 ANC E2 = 1.000

1 TIMES THROUGH BLOCK OF 4201 LOADS

LCAC LIMIT = 29.79999

STEP	TYPE	STMIN	STMAX	ENN
201	1	0.0	0.85000	1.000000
451	1	0.11000	0.45000	1.000000
701	1	0.11000	0.45000	1.000000
951	1	0.11000	0.75000	1.000000
1201	1	0.11000	0.55000	1.000000
1451	1	0.11000	0.65000	1.000000
1701	1	0.11000	0.35000	1.000000
1951	1	0.11000	0.45000	1.000000
2201	1	0.11000	0.35000	1.000000
2451	1	0.11000	0.35000	1.000000
2701	1	0.11000	0.55000	1.000000
2951	1	0.11000	0.35000	1.000000
3201	1	0.11000	0.35000	1.000000
3451	1	0.11000	0.45000	1.000000



1:00000  
1:00000  
1:00000

0:35000  
0:35000  
0:35000

0:11000  
0:11000  
0:11000

1  
1  
1

3701  
3951  
4201

TYPE

TYPE

TYPE

TYPE

TYPE

BLOCK

1

SPECTRUM FROM A7 CRITICAL POINT #1 FROM U166808

AKT = 2.72

RELAXATION CONSTANT C1= 10000000.00

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE  
FLIGHT CR BLOCK NO. 1

DAMAGE FROM PLASTIC STRAINS= 0.46892278E-03

DAMAGE PER THIS SET= 0.46267733E-02

TOTAL ENN/CYC =, 0.46267733E-02

# INPUT OF RANDL GENERATED LOADS

<sup>1</sup>  
 A7 CRITICAL PCINT #1 FROM U166808  
 7075-16 AL  
 72  
 .2801  
 .5154  
 .6141  
 .6838  
 1.  
 10000000.  
 2.72  
 4201  
 29.8  
 1  
 1  
 1

C.4  
 71.7 MIL-HCBK-5A  
 56.3 MIL-HCBK-5A  
 44.6 MIL-HCBK-5A  
 38.1 MIL-HCBK-5A  
 1.  
 -1.836  
 4 7075  
 5 7075  
 6 7075  
 7 7075  
 10000.



OUTPUT CF 4201 RANDU GENERATED LOADS, IPRINT = 3

1 DATA DECKS ARE TO BE PROCESSED.  
NO COUNTING METHODS USED  
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION

SPECTRUM FROM A7 CRITICAL POINT #1 FROM U166808  
MATERIAL TYPE -- 7075-16 AL

TENSILE YIELD STRESS (KSI) -- 72.00000

LCF STRAIN INTERCEPT = 0.40000

INVERSE OF COFFIN-MANSON SLOPE -1.8360C

ELASTIC MODULUS = 10000.00000

COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DATA

SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I)	B(I)	C(I)
10**4	-0.00200	0.28010
10**5	-0.00220	0.51540
10**6	-0.00140	0.61410
10**7	-0.00130	0.68380

UNNOTCHED COUPON S-N DATA DERIVED FROM  
INFORMATION SUPPLIED FROM MIL-HDBK-5A

RESIDUAL STRESS RELAXATION FUNCTION

ENEP = C1/(KTSMAX\*\*E1 \* KTSMEAN\*\*E2)  
WHERE C1 = 0.10000000E 08, E1 = 1.000 ANC E2 = 1.000

1 TIMES THROUGH BLOCK OF 4201 LOADS

LCAC LIMIT = 29.79999

STEP	TYPE	STMIN	STMAX	ENN
201	1	0.0	0.85000	1.00000
451	1	0.11000	0.45000	1.00000
701	1	0.11000	0.45000	1.00000
951	1	0.11000	0.75000	1.00000
1201	1	0.11000	0.55000	1.00000
1451	1	0.11000	0.65000	1.00000
1701	1	0.11000	0.35000	1.00000
1951	1	0.11000	0.45000	1.00000
2201	1	0.11000	0.35000	1.00000
2451	1	0.11000	0.55000	1.00000
2701	1	0.11000	0.35000	1.00000
2951	1	0.11000	0.35000	1.00000
3201	1	0.11000	0.35000	1.00000
3451	1	0.11000	0.45000	1.00000

1:00000  
1:00000  
1:00000

0:35000  
0:35000  
0:35000

0:11000  
0:11000  
C:11000

1  
1  
1

3701  
3951  
4201

TYPE

TYPE

TYPE

TYPE

TYPE

BLOCK

1



SPECTRUM FROM A7 CRITICAL PCINT #1 FROM U166808

AKT = 2.72

RELAXATION CONSTANT C1= 1  
FLIGHT CR BLOCK NO.

10000000.00

DAMAGE FROM PLASTIC STRAINS= 0.46892278E-03

DAMAGE PER THIS SET= 0.47398917E-02

TOTAL ENN/CYC =, 0.47398917E-02

# COMPUTER PROGRAM

\*\*\*\*\*

## MODULE I INPUT ROUTINE FOR THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS

\*\*\*\*\*

### INPUT

DATA CARD 1. NDECK = THE NUMBER OF DATA DECKS TO  
BE RUN SEQUENTIALLY  
IPRINT= THE VALUE CONTROLLING THE  
WRITE STATEMENTS  
1. PERMITS MAXIMUM PRINTCUT  
2. SUPPRESSES RANGE-PAIR  
PRINTING  
3. MAXIMUM SUPPRESSION OF  
PRINTCUT  
IRPCM = THE VALUE CONTROLLING THE  
ENTRY INTO THE RANGE-PAIR  
COUNTING SUBROUTINE  
1. ENTER RANGE-PAIR COUNTING  
SUBROUTINE  
2. SKIP RANGE-PAIR COUNTING  
SUBROUTINE  
FORMAT 3I4

EACH DATA DECK CONTAINS THE FOLLOWING CARDS -

CARD 1. TEST IDENTIFYING INFORMATION  
FORMAT 16A4

CARD 2. TM = MATERIAL TYPE  
TYS = TENSILE YIELD STRESS (KSI)  
EPSD = LCF STRAIN INTERCEPT  
COFMAN = INVERSE OF COFFIN-MANSON  
SLOPE  
ELMOD = MODULUS OF ELASTICITY (KSI)  
FCRMAT 4A4,3F18.5,F10.2

CARDS 3,...,6. A(N) N=4,7 (A,B,C ARE COEFFICIENTS  
OF SECOND ORDER LEAST  
SQUARE FIT OF S-N DATA,  
FOR CURVE OF 10\*\*N  
CYCLES.)  
B(N)  
C(N) (STMAX = A(N)\*STMIN\*\*2  
+ B(N)\*STMIN + C(N))  
TITLE1 (TITLE1,TITLE2,TITLE3,  
TITLE2 TITLE4 IDENTIFIES THE  
TITLE3 SOURCE OF THE  
TITLE4 S-N DATA)  
N (PUNCHED IN COLUMN 72.  
FOR INFO.)  
MATERIAL TYPE (COLUMNS 73.-80. FOR  
INFO ONLY.)  
FORMAT 3F18.5,4A4

CARD 7. C1 (CONSTANTS TO BE USED IN  
CALCULATION OF EQUILIBRIUM  
E1 PERIOD, ENEP.)  
(ENEP=C1/(KTSMAX\*\*E1\*KTSMEAN  
\*\*E2))  
E2  
FCRMAT 3F18.5







AD-A039 651

NAVAL POSTGRADUATE SCHOOL MONTEREY CALIF

F/G 1/3

A STUDY OF SPECTRUM LOADING AND RANGE-PAIR COUNTING METHOD EFFE--ETC(U)

MAR 77 J S ATKINSON

UNCLASSIFIED

NL

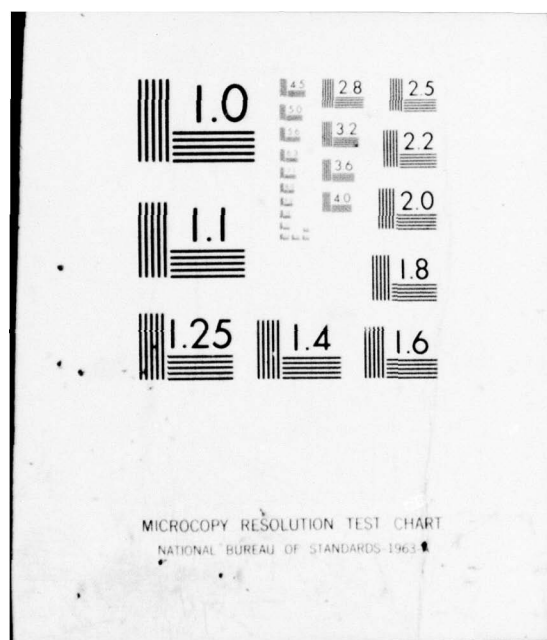
2 OF 2  
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A039651



END

DATE  
FILMED

6-77





C  
C  
C  
C

# INPUT OF DATA PECULIAR TO A SEQUENCE

```

65 REAC(5,65)AKT
FCRMT(F18.5)
32 READ(5,32) NBLOCK,JLEVEL,NTYPE
FCRMT(3110)
WRITE(6,34) NBLOCK,JLEVEL
34 FCRMT(/I10,23H TIMES THROUGH BLOCK OF,I10,6H LOADS)
REAC(5,35) TLL
35 FCRMT(F18.5)
WRITE(6,33) TLL
33 FCRMT(/ 5X,13H LOAD LIMIT =,F18.5)
IF(ISKIP.EQ.100) GO TO 37
READ(5,88)(IDUMMY ,ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),
1K=1,JLEVEL)
88 FCRMT(I4,2X,I4,2X,F18.5,1X,F18.5,1X,F18.5,1X)
37 WRITE(6,38)
38 FCRMT(/I1H STEP TYPE,10X,6H STMIN,14X,6H STMAX,15X,
14H ENN)
IF(ISKIP.EQ.100) GO TO 89
WRITE(6,36)(K,ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=1,
1JLEVEL)
GO TO 91
89 WRITE(6,36)(K,ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=201,
1JLEVEL,250)
91 WRITE(6,39)
36 FCRMT(1X,I4,2X,I4,2X,F18.5,1X,F18.5,1X,F18.5)
39 FCRMT(/47H BLOCK TYPE TYPE TYPE TYPE TYPE TYPE TYPE
15H TYPE/)
CC 42 JJ=1,NBLOCK
REAC(5,40) IDUMMY , (NN(JJ,KK),KK=1,NTYPE)
40 WRITE(6,40) JJ , (NN(JJ,KK),KK=1,NTYPE)
FCRMT(1315)
42 CCNTINUE
SLMENN=0.0
SLMNC=0.0
RES(1)=0.0
WRITE(6,8)T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T
114,T15,T16
51 WRITE(6,51) (AKT)
FCRMT(/77H AKT = ,(F6.2))
55 WRITE(6,55)C1
FCRMT(/24H RELAXATION CONSTANT C1=,F15.2)
IF (IRPCM.GE.2) GO TO 59
11 WRITE(6,11)
FCRMT(38HOSPECTRUM SUBJECTED TO THE RANGE-FAIR
118H-COUNTING TECHNIQUE)
59 CCNTINUE
DC 1002 KFL=1,NBLOCK
JJJ=1
DC 60 J=1,JLEVEL
DC 70 KK=1,NTYPE
IF (NN(KFL,KK).EQ.0) GO TO 60
IF (ITYPE(J).EQ.NN(KFL,KK)) GO TO 150
70 CCNTINUE
150 STMIN(JJJ)=RTMIN(J)*TLL
STMAX(JJJ)=RTMAX(J)*TLL
ENN(JJJ)=RNN(J)
J,J=JJJ+1
60 CCNTINUE
JLEVEL=JJJ-1
CALL CORE(KFL)
IFRINT=2
1002 CCNTINUE
597 CCNTINUE
595 CCNTINUE
596 CCNTINUE
580 STCP
ENC
C

```





```

400 IF (ASMAX.LE.TYS) GO TO 410
    ECRES=-ASMAX+TYS
    GC TO 440
410 IF (ASMIN.GE.-TYS) GO TO 430
420 ECRES=-ASMIN-TYS
    GC TO 440
430 ECRES=0.0
440 DIF=RES(I)-EQRES
C
C
C
C
    CALCULATE RELAXATION FUNCTION
C
    ABMAX=ABS(ASMAX)
    ABMIN=ABS(ASMIN)
    ABMEAN=ABS(ASMEAN)
    IF (ABMAX.LT.1.) ABMAX=1.
    IF (ABMEAN.LT.1.) ABMEAN=0.5
    IF (ABMIN-ABMAX) 444,444,442
442 AEN=ABMIN
    GC TO 446
444 AEN=ABMAX
446 ENEP=C1/(ABM**E1*ABMEAN**E2)
    IF (IPRINT.GE.3) GO TO 351
    WRITE(6,350) STMAX(J),STMIN(J),SIGMAX(IRAIN),SIGMIN(IR
    AIN),RES(J),EQRES,ENN(J),ENEP,J,IRAIN
350 FCRMAT(6(F7.2,1X),F6.2,1X,E15.8,15,15)
351 CCNTINUE
C
C
C
C
    CALCULATE RESIDUAL STRESS RELAXATION
C
    IRAIN=IRAIN+1
    AECIF=ABS(DIF)
    GC TO 360
C
C
C
    OMITTED "GO TO 560" CARD FROM THIS POSITION, AS SHOWN
    IN MANUAL
C
360 IF (ABDIF.LT.5.) GO TO 560
370 IF (1000.*ENN(J).LT.ENEP) GO TO 560
    IF (ENN(J).LE.10.) GO TO 560
380 NFLAG=0
    NFLAG2=10
    IRAIN=IRAIN-1
    DUMMY=ENN(J)
450 IF (DUMMY-ENEP) 470,460,460
460 DUMMY=DUMMY/2.
    NFLAG=NFLAG+1
    GC TO 450
470 CYCINT=DUMMY/10.
    CC 500 K=1,10
    DECK=FLOAT(K)
    EN(K)=CYCINT*DECK
    IF (K.EQ.1) GO TO 490
480 EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)
    GC TO 500
490 EX(K)=1.+EXP(-2.303*EN(K)/ENEP)
500 CCNTINUE
    IF (NFLAG.EQ.0) GO TO 530
510 NFLAG2=NFLAG+10
    CC 520 K=11,NFLAG2
    EN(K)=2.*DUMMY
    EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)
    DUMMY=2.*DUMMY
520 CCNTINUE
530 CC 559 K=1,NFLAG2
    SIGMAX(IRAIN)=ASMAX+ECRES+DIF*EX(K)/2.
    SIGMIN(IRAIN)=SIGMAX(IRAIN)-ASMAX+ASMIN
    RACYC(IRAIN)=EN(K)
545 IF (K.EQ.1) GO TO 540

```



```

539 RNCYC(IRAIN)=RNCYC(IRAIN)-EN(K-1)
540 IF (IPRINT.GE.3) GO TO 551
    WRITE(6,550)SIGMAX(IRAIN),SIGMIN(IRAIN),RNCYC(IRAIN),I
    IRAIN
550 FCRMAT(16H RELAXATION      ,2(F7.2,1X),16X,F6.2,31X,I6)
551 CCNTINUE
    IRAIN=IRAIN+1
559 CCNTINUE
560 CCNTINUE
    RES(I)=EQRES+DIF*EXP(-2.303*ENN(J)/ENEP)
570 CCNTINUE
569 RES(I)=RES(J)
    IN=IRAIN-1

```

\*\*\*\*\*

### MODULE III CYCLE CCUNTING TECHNIQUE

\*\*\*\*\*

CALL SUBROUTINE TO RANGE-PAIR CCUNT SPECTRUM

```

    IF(IRPCM.GT.1) GO TO 591
    CALL RPCM(IN)
    GC TO 592
591 CCNTINUE
592 KFMAX=IN
    CCNTINUE

```

\*\*\*\*\*

### MODULE IV DAMAGE ACCUMULATION CALCULATION

\*\*\*\*\*

```

    IF(IPRINT.GE.3) GO TO 552
    WRITE(6,53)
53 FCRMAT(//1X,39H LOCAL STRESSES AND PLASTIC STRAINS WIT
    124HH RESULTING FATIGUE LIFE//10X,4HSTEP,10X,
    114H-PLASTIC STRAIN,10X,10HMAX OR MIN,15X,6HDAMAGE)
552 CCNTINUE

```

CALCULATE DAMAGE FROM PLASTIC STRAIN CYCLES

```

    SUMDEL=0.
    CC 531 JKL=1,NLEVEL
    AA=1.
    IF(PLSTRA(JKL)) 532,531,533
532 AA=-1.
533 PLSTRA(JKL)=AA*PLSTRA(JKL)
    CYCLES=(PLSTRA(JKL)/EPSD)**CCFMAN
    DAM=1./CYCLES
    SUMNC=SUMNC+DAM
    SUMDEL=SUMDEL+DAM
    IF(IPRINT.GE.3) GO TO 531
    IF (AA) 535,535,537
535 WRITE(6,199)JKL,PLSTRA(JKL),DAM
199 FCRMAT(10X,I4,12X,F10.5,15X,3HMIN,10X,E14.6)
    GC TO 531
537 WRITE(6,219)JKL,PLSTRA(JKL),DAM
219 FCRMAT(10X,I4,12X,F10.5,15X,3HMAX,10X,E14.6)
531 CCNTINUE
    WRITE(6,541) SUMDEL

```





```

SUBROUTINE RPCM(NPKS)
THIS PROGRAM EMPLOY THE RANGE-PAIR CYCLE COUNTING
METHOD TO GENERATE ANALYSIS SPECTRUM FROM A GIVEN
LCAC SPECTRUM

```

PFCGRAM ARRAYS  
(INFORMATION NEEDED TO CHANGE DIMENSIONS)

ARRAY NAME	DEFINITION	DIMENSION
SIGMAX KK	PEAKS OF THE INPUT LOAD SPECTRUM THE NUMBER OF ADDITIONAL CYCLES (EXCLUDING INPUT CYCLES) WHICH THE PROGRAM WILL GENERATE	NPKS + KK
SIGMIN	VALLEYS OF THE INPUT LOAD SPECTRUM	NPKS + KK
RNCYC	K COUNTERS OF THE PEAKS AND VALLEYS	NPKS + KK
NSTEP	STEP NUMBERS OF THE INPUT SPECTRUM	NPKS + KK
RES	RESIDUE SPECTRUM	2*NPKS
INDEX	STEP NUMBERS OF ELEMENTS IN RES	2*NPKS
CYCLE	RANGE-PAIR COUNTED CYCLES	NPKS + KK
RNECYC	K COUNTERS OF THE CYCLES OF THE UNSORTED ANALYSIS SPECTRUM	NPKS + KK
NNSTEP	STEP NUMBERS OF THE ELEMENTS OF THE UNSORTED ANALYSIS SPECTRUM	NPKS + KK
ISAVE	VALUES OF NSTEP(J) SUCH THAT RNCYC(J) IS <1.0 AND VALUES OF NSTEP(J) SUCH THAT SIGMAX(J-1)= SIGMAX(J) AND SIGMIN(J-1)=SIGMIN(J)	99

```
CCMPCN/MSAL/RNCRYC( 4205),KPMAX,IPRINT  
CCMPCN/MDEC1/SIGMAX( 4205),SIGMIN( 4205)  
CCMPCN/MDEC2/NSTEP( 4205),LR,KMAX,KMIN,K31  
CCMPCN/MDECR/RES( 4205),INDEX( 4205),IND1,IND2,IND3,IND4,KIND  
CCMPCN/MCYG/CYCLE(200,2),RNECYC( 4205),NNSTEP( 4205)  
CCMPCN/MCGDE/L,LIND  
DIPENSICN ISAVE(4205),TITLE(8)
```

```

9999  CIPERSON 1SAVE(4203,1)11EE(87
      NPLNCH = 0
      CC 8000 I=1,NPKS
8000  NSTEP(I) = I
      IF(I*PRINT.GE.2)GO TO 103
      WRITE(6,20)NPKS
20    FCRMAT(1H0,40HTHE NUMBER OF PEAKS OR VALLEYS IN THE IN
120    PUT LOAD SPECTRUM = ,I5//)
      WRITE(6,22)
22    FCRMAT(39X,5HSIGMA/10X,4HSTEP,13X,7HMAXIMUM,16X,
17HMINIMUM,12X,9HCCOUNTER K/)
      WRITE(6,25) (NSTEP(I),SIGMAX(I),SIGMIN(I),RACYC(I),I =
1 1,NPKS)
25    FCRMAT(8X, 15,10X,E13.6,10X,E13.6,10X,F10.5)
103    CC CONTINUE

```

SCRT THROUGH THE LOAD SPECTRUM - PULL OUT TFCSE PEAKS  
AND VALLEYS WHERE COUNTER K IS LESS THAN 1.0

```

J=1
J=C
NRES = 1
NCYNO = 100
JMAX = 0
CC 100 I=1,NPKS
IF (RNCYC(I),GE. 1.0) GO TO 100
X1 = SIGMAX(I)
X2 = SIGMIN(I)
CALL CYCGEN(X1,X2,RNCYC(I),NSTEP(I))
ISAVE(J) = I

```



```

      J = J + 1
100  CCNTINUE
      JMAX = J - 1
      NPKSN = NPKS - JMAX
      IF (JMAX.EQ.0) GO TO 200
      WRITE(6,23) (ISAVE(K),K = 1,JMAX)
      IF (IPRINT.GE.2) GO TO 101
23   FORMAT(1H0,40HSTEP NUMBERS OF THOSE PEAKS AND VALLEYS
151  IN THE LOAD SPECTRUM WHOSE COUNTER K IS LESS THAN 1
121  0//((17I7))
101  CCNTINUE
      DO 110 J = 1,JMAX
      I = ISAVE(J) - (J-1)
      NPKN = NPKS - J
      IF (I.EQ.NPKN) GO TO 110
      CC 115 II = I,NPKN
      SIGMAX(II) = SIGMAX(II+1)
      SIGMIN(II) = SIGMIN(II+1)
      NSTEP(II) = NSTEP(II+1)
      RNCYC(II) = RNCYC(II+1)
115  CCNTINUE
110  CCNTINUE
200  CCNTINUE

```

CCCCC

SCRT THROUGH THE LOAD SPECTRUM DATA-COMBINE STEPS WITH IDENTICAL PEAKS AND VALLEYS WHICH OCCUR CONSECUTIVELY

```

      J = 1
      DO 300 I = 2,NPKSN
      IF (SIGMAX(I) .NE. SIGMAX(I-1)) GC TO 300
      IF (SIGMIN(I) .NE. SIGMIN(I-1)) GC TO 300
      ISAVE(J) = I
      RNCYC(I-1) = RNCYC(I-1) + RNCYC(I)
      J = J + 1
300  CCNTINUE
      IF (J.EC.1) GO TO 6000
      JMAS = J - 1
      DO 311 J = 1,JMAS
      I = ISAVE(J) - (J-1)
      NPKN = NPKSN - J
      IF (I .EQ. NPKN) GO TO 311
      CC 316 II = I,NPKN
      SIGMAX(II) = SIGMAX(II+1)
      SIGMIN(II) = SIGMIN(II+1)
      NSTEP(II) = NSTEP(II+1)
      RNCYC(II) = RNCYC(II+1)
316  CCNTINUE
311  CCNTINUE
      NPKSN = NPKSN - JMAS

```

CCCCC

RANGE PAIR COUNT THE ADJUSTED LOAD SPECTRUM

```

600C  I=1
      KB=0
      L=JMAX
      KPIN=0
      KMAX=0
      LR=0
      K=1=0
1   IF (RNCYC(I) .GT. 1.0) GO TO 400
      IF (KB .NE. 0) GO TO 5
      X1=SIGMAX(I)
      X2=SIGMIN(I)
      IND1=NSTEP(I)
      INC2=IND1
      I=I+1
      KB=1
      GC TO 1

```

```

5      X3=SIGMAX(I)
      X4=SIGMIN(I)
      IND3=NSTEP(I)
      INC4=IND3
      KMIN=1
      KMAX=0
      K31=0
      IF (RNCYC(I) .EQ. 1.0) GO TO 6
      KEY=1
      KIND=1
      GC TO 415
6      KEY=0
      CYCNC=AIN(T(RNCYC(I)+0.5)
      CALL DECIDE(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)
      GC TO (10,10,30),KCYGEN
1000C  KE=1
10C
C
C
C
C
C
C

```

REVERSE CRDER OF NEXT TWC CARDS TO RUN. "I=I+1" GCES  
AFTER "IF(KMIN.NE.1) GO TO 36" AS PER ERRATA SHEET IN  
PRINTED MANUAL. CHECK PROGRAM WITH CARDS IN THE  
MANUAL'S CRDER

```

      IF (KMIN .NE. 1) GO TO 36
      I=I+1
      IF (I .LE. NPKSN) GO TO 5
      RES(LR+1) = X1
      RES(LR+2) = X2
      INDEX(LR+1) = IND1
      INDEX(LR+2) = IND2
      LRMAX = LR+2
      GC TO 2000
30      IF (KMIN .NE. 1) GO TO 35
12      I=I+1
      IF (I .LE. NPKSN) GO TO 31
      RES(LR+1) = X1
      RES(LR+2) = X2
      RES(LR+3) = X3
      INDEX(LR+1) = IND1
      INDEX(LR+2) = IND2
      INDEX(LR+3) = IND3
      LRMAX = LR+3
      GC TO 2000
31      X4=SIGMAX(I)
      IND4=NSTEP(I)
      KMAX=1
      KMIN=0
      K31=1
32      IF (RNCYC(I) .GT. 1.0) GO TO 40
      GC TO 6
40      KEY = 1
      KIND = 0
      GC TO 415
35      X4 = SIGMIN(I)
      INC4 = NSTEP(I)
      KMIN = 1
      KMAX = 0
      K31 = 0
      GC TO 32
36      X3 = SIGMIN(I)
      INC3 = NSTEP(I)
      KMIN = 1
      KMAX = 0
      GC TO 12
400     KEY = 1
      IF (KB .NE. 0) GO TO 410
      X1 = SIGMAX(I)
      X2 = SIGMIN(I)
      X3 = SIGMAX(I)
      X4 = SIGMIN(I)
      INC1 = NSTEP(I)

```









```

SUBROUTINE CYCGEN(Y1,Y2,CYCPF,NSTEPP)
COMMON/MCYG/CYCLE(200,2),RNECYC( 4205),NNSTEP( 4205)
COMMON/MCGDE/L,LIND

```

```

THIS SUBROUTINE GENERATES CYCLES FOR THE ANALYSIS
SPECTRUM FROM DATA SUPPLIED BY SUBROUTINE DECIDE

```

```

LINC=0
L=L+1
CYCLE(L,1)=Y1
CYCLE(L,2)=Y2
RNECYC(L)=CYCPF
NNSTEP(L)=NSTEPP
IF (L.EC.1) GO TO 100
IF (CYCLE(L-1,1).NE.CYCLE(L,1)) GC TO 100
IF (CYCLE(L-1,2).NE.CYCLE(L,2)) GC TO 100
L=L-1
RNECYC(L)=RNECYC(L)+1.0
LIND=1
RETURN
END

```

```

SUBROUTINE DECIDE(X1,X2,X3,X4,KEY,I,CYCNC,KCYGEN)
COMMON/MDEC1/SIGMAX( 4205),SIGMIN( 4205)
COMMON/MDEC2/NSTEP( 4205),LR,KMAX,KMIN,K31
COMMON/MDEC3/RES( 4205),INDEX( 4205),IND1,IND2,IND3,IN
1C4,KINC
COMMON/MCYG/CYCLE(200,2),RNECYC( 4205),NNSTEP( 4205)
COMMON/MCGDE/L,LIND

```

C  
C  
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C

THIS SUBROUTINE DECIDES WHETHER OR NOT THE VALUES X1,  
X2, X3, AND X4 FROM THE ADJUSTED LOAD SPECTRUM SATISFY  
THE RANGE-PAIR COUNTING CONCITIONS

```

KFIRST=0
IF (K31.NE.0) GO TO 11
10 IF (X3.LE.X2) GO TO 200
11 IF (X2.GT.X1) GO TO 210
IF (X2.LT.X4.OR.X3.GT.X1) GO TO 500
150 IF (X2.GT.X3) GO TO 151
CALL CYCGEN(X3,X2,1.0,NSTEP(I))
GC TO 152
151 CALL CYCGEN(X2,X3,1.0,NSTEP(I))
152 X1=X1
X2=X4
IF (INC3.NE.IND2) LIND=1
INC2=INC4
KCYGEN = 1
IF (KEY.NE.0) GO TO 110
RETURN
210 IF (X2.GT.X4.OR.X3.LT.X1) GO TO 500
GC TO 150
200 X1=X1
X2=X4
INC2=IND4
KCYGEN = 2
IF (KEY.EQ.0) RETURN
CYCNC=CYCNC-1.0
GC TO 110

```

C  
C  
C  
C  
C  
C

ADD X1 TO THE RESIDUE SPECTRUM

```

500 LR=LR+1
RES(LR)=X1
INDEX(LR)=IND1
X1=X2
X2=X3
X3=X4
IND1=IND2
IND2=INC3
INC3=INC4
KCYGEN = 3
IF (KEY.NE.0) GO TO 110
RETURN
110 GC TO (1150,1200,1500),KCYGEN
1150 IF (CYCNC.GT.1.0) GO TO 1151
IF (CYCNC.LE.0.0) RETURN
1153 CYCNC = CYCNC - 1.0
GC TO 1152
1151 IF (LIND.EQ.1) GO TO 1153
IF (INC3.NE.IND4) GO TO 1153
RNECYC(L) = RNECYC(L) + CYCNC - 2.0
CYCNC = 1.0
1152 IF (KMAX.NE.1) GO TO 111
X3 = SIGMIN(I)
IND3 = NSTEP(I)
IF (CYCNC.GT.0.0) GO TO 112

```



```

      KMIN = 1
      KMAX = 0
      KCYGEN = 3
      RETURN
1200  IF (CYCNO.LE.0.0) RETURN
      CYCNO = CYCNO - 1.0
      X3 = SIGMAX(I)
      X4 = SIGMIN(I)
      KFIRST = 1
      GC TO 113
111   X3 = SIGMAX(I)
      X4 = SIGMIN(I)
      IF (KFIRST.NE.0) GO TO 113
      CYCNO = CYCNO - 1.0
      KFIRST = 1
113   INC3 = NSTEP(I)
      IND4 = IND3
      KMIN = 1
      KMAX = 0
      GC TO 10
1500  IF (KMAX.NE.0) GO TO 1510
      IF (CYCNO.LE.0.0) RETURN
      CYCNO = CYCNO - 1.0
112   X4 = SIGMAX(I)
      IND4 = NSTEP(I)
      KMAX = 1
      KMIN = 0
      GC TO 11
1510  X4 = SIGMIN(I)
      INC4 = NSTEP(I)
      KMAX = 0
      KMIN = 1
      GC TO 10
      END

```

C  
C  
C

```

SLERCUTINE DECRES(LRMAX,NCYNO)
CCMMON/MCGDE/L,LIND
CCMMCN/MDECR/RES( 4205),INDEX( 4205),IND1,IND2,IND3,IN
104,KIND

```

C  
C  
C  
C  
C  
C

THIS SUBROUTINE DECIDES WHETHER OR NOT THE ELEMENTS OF  
THE RESIDUE SPECTRUM SATISFY THE RANGE PAIR-COUNTING  
CONDITIONS

```

      K = 0
      NCYNO = 0
      X1 = RES(1)
      X2 = RES(2)
      X3 = RES(3)
      X4 = RES(4)
      IND1 = INDEX(1)
      INC2 = INDEX(2)
      IND3 = INDEX(3)
      INC4 = INDEX(4)
      J = 4
10    IF (X2.GT.X1) GO TO 100
150   IF (X2.LT.X4.OR.X3.GT.X1) GO TO 500
      IF (X2.GT.X3) GO TO 151
      CALL CYCRES(X3,X2,1.0,IND3)
      GC TO 152
151   CALL CYCRES(X2,X3,1.0,IND2)
152   NCYNO = NCYNO + 1
      X1 = X1
      X2 = X4
      INC2 = IND4
      IF (J.EQ.LRMAX) GO TO 300
      IF ((J+1).EQ.LRMAX) GO TO 315
      X3 = RES(J+1)
      X4 = RES(J+2)
      IND3 = INDEX(J+1)
      IND4 = INDEX(J+2)
      J = J+2
      GC TO 10
100   IF (X2.GT.X4.OR.X3.LT.X1) GO TO 500
      GC TO 150
500   K = K + 1
      RES(K) = X1
      INDEX(K) = IND1
      J = J + 1
      IF (J.GT.LRMAX) GO TO 330
      X1 = X2
      X2 = X3
      X3 = X4
      X4 = RES(J)
      IND1 = IND2
      INC2 = IND3
      INC3 = IND4
      IND4 = INDEX(J)
      GC TO 10
300   K = K + 1
      RES(K) = X1
      RES(K+1) = X2
      INDEX(K) = IND1
      INDEX(K+1) = IND2
      LRMAX = K+1
      RETURN
315   K = K+1
      RES(K) = X1
      RES(K+1) = X2
      RES(K+2) = RES(J+1)
      INDEX(K) = IND1
      INDEX(K+1) = IND2

```

```
INDEX(K+2) = INDEX(J+1)
LRMAX = K+2
RETURN
330 K = K+1
RES(K) = X2
RES(K+1) = X3
RES(K+2) = X4
INDEX(K) = IND2
INDEX(K+1) = IND3
INDEX(K+2) = IND4
LRMAX = K+2
RETURN
END
```

CC



```
SLERCUTINE CYCRES(Y1,Y2,CYCPF,NSTEPP)  
CCMMON/MCYG/CYCLE(200,2),RNECYC( 4205),NNSTEP( 4205)  
CCMMON/MCGDE/L,LIND
```

C  
C  
C  
C  
C

THIS SUBROUTINE GENERATES CYCLES FOR THE ANALYSIS  
SPECTRUM FROM DATA SUPPLIED BY SUBROUTINE DECRES

```
L = L+1  
CYCLE(L,1) = Y1  
CYCLE(L,2) = Y2  
RNECYC(L) = CYCPF  
NNSTEP(L) = NSTEPP  
RETURN  
END
```

C  
C  
C  
C  
C

# RANDOMIZE SPECTRUM A LOADS FOR STMAX

```

IS KIP=100
IA=0
IB=0
IC=0
ID=0
IE=0
IF=0
IG=0
IH=0
II=0
IJ=0
IK=0
IL=0
ITCTAL=0
IX=9
700 CALL RANDU(IX,IY,YFL)
IX=IY
IF(ITOTAL.EQ.4201) GO TO 790
IF((YFL.GE..0.).AND.(YFL.LT..1)) GO TO 750
IF((YFL.GE..1.).AND.(YFL.LT..2)) GO TO 751
IF((YFL.GE..2.).AND.(YFL.LT..3)) GO TO 752
IF((YFL.GE..3.).AND.(YFL.LT..4)) GO TO 753
IF((YFL.GE..4.).AND.(YFL.LT..5)) GO TO 754
IF((YFL.GE..5.).AND.(YFL.LT..6)) GO TO 755
IF((YFL.GE..6.).AND.(YFL.LT..7)) GO TO 756
IF((YFL.GE..7.).AND.(YFL.LT..8)) GO TO 757
IF((YFL.GE..8.).AND.(YFL.LT..9)) GO TO 758
IF((YFL.GE..9.).AND.(YFL.LT..1.)) GO TO 759
750 IF(IA.EQ.2) GO TO 700
ITCTAL=ITCTAL+1
IA=IA+1
RTMAX(I)=1.25
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
751 IF(IB.EC.4) GO TO 700
ITCTAL=ITCTAL+1
IB=IB+1
RTMAX(I)=1.15
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
752 IF(IC.EC.15) GO TO 700
ITCTAL=ITCTAL+1
IC=IC+1
RTMAX(I)=1.05
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
753 IF(ID.EQ.44) GO TO 700
ITCTAL=ITCTAL+1
ID=ID+1
RTMAX(I)=.95
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
754 IF(IE.EC.136) GO TO 700

```

```

ITCTAL=ITOTAL+1
IE=IE+1
RTMAX(I)=.85
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
755 IF( IK.EQ.250) GO TO 700
ITOTAL=ITOTAL+1
IK=IK+1
RTMAX(I)=.75
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
756 IF( IG.EQ.450) GO TO 700
ITCTAL=ITCTAL+1
IG=IG+1
RTMAX(I)=.65
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
757 IF( IH.EQ.650) GO TO 700
ITOTAL=ITCTAL+1
IH=IH+1
RTMAX(I)=.55
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
758 IF( II.EQ.950) GO TO 700
ITCTAL=ITOTAL+1
II=II+1
RTMAX(I)=.45
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
759 IF( IJ.EQ.1700) GO TO 700
ITOTAL=ITOTAL+1
IJ=IJ+1
RTMAX(I)=.35
RTMIN(I)=.11
ITYPE(I)=1
RNN(I)=1.
I=I+1
GC TO 700
790 CCNTINUE

```

CCCCC

RANDOMIZE SPECTRUM A LOADS FOR STMIN

```

IA=0
IB=0
IC=0
IC=0
IE=0
IF=0
IG=0
IH=0
II=0
IJ=0
IK=0
IL=0
I=1

```



```

ITCTAL=0
IX=583
773 CALL RANDU(IX,IY,YFL)
IX=IY
IF(ITOTAL.EQ.101) GO TO 791
IF((YFL.GE.0.).AND.(YFL.LT..06)) GO TO 760
IF((YFL.GE..07).AND.(YFL.LT..13)) GO TO 761
IF((YFL.GE..14).AND.(YFL.LT..20)) GO TO 762
IF((YFL.GE..21).AND.(YFL.LT..27)) GO TO 763
IF((YFL.GE..28).AND.(YFL.LT..34)) GO TO 764
IF((YFL.GE..35).AND.(YFL.LT..41)) GO TO 765
IF((YFL.GE..42).AND.(YFL.LT..48)) GO TO 766
IF((YFL.GE..49).AND.(YFL.LT..55)) GO TO 767
IF((YFL.GE..56).AND.(YFL.LT..62)) GO TO 768
IF((YFL.GE..63).AND.(YFL.LT..69)) GO TO 769
IF((YFL.GE..70).AND.(YFL.LT..76)) GO TO 770
IF((YFL.GE..77).AND.(YFL.LT..83)) GO TO 771
IF((YFL.GE..84).AND.(YFL.LT..1.0)) GO TO 773
760 IF(IA.EQ.50) GO TO 773
ITOTAL=ITOTAL+1
IA=IA+1
HCLD(I)=0.
I=I+1
GC TO 773
761 IF(IB.EQ.20) GO TO 773
ITCTAL=ITOTAL+1
IB=IB+1
HCLD(I)=-.04
I=I+1
GC TO 773
762 IF(IC.EQ.10) GO TO 773
ITCTAL=ITOTAL+1
IC=IC+1
HCLD(I)=-.08
I=I+1
GC TO 773
763 IF(ID.EQ.6) GO TO 773
ITCTAL=ITOTAL+1
ID=ID+1
HCLD(I)=-.12
I=I+1
GC TO 773
764 IF(IE.EQ.3) GO TO 773
ITCTAL=ITOTAL+1
IE=IE+1
HCLD(I)=-.16
I=I+1
GC TO 773
765 IF(IM.EQ.3) GO TO 773
ITOTAL=ITOTAL+1
IM=IM+1
HCLD(I)=-.20
I=I+1
GC TO 773
766 IF(IG.EQ.3) GO TO 773
ITCTAL=ITOTAL+1
IG=IG+1
HCLD(I)=-.25
I=I+1
GC TO 773
767 IF(IH.EQ.2) GO TO 773
ITCTAL=ITOTAL+1
IH=IH+1
HCLD(I)=-.29
I=I+1
GC TO 773
768 IF(II.EQ.1) GO TO 773
ITOTAL=ITOTAL+1
II=II+1
HCLD(I)=-.33
I=I+1
GC TO 773

```

```

769 IF(IJ.EQ.1) GO TO 773
    ITCTAL=ITOTAL+1
    IJ=IJ+1
    HCLD(I)=-.37
    I=I+1
770 GC TO 773
    IF(IK.EQ.1) GO TO 773
    ITCTAL=ITOTAL+1
    IK=IK+1
    HCLC(I)=-.41
    I=I+1
771 GC TO 773
    IF(IL.EQ.1) GO TO 773
    ITCTAL=ITOTAL+1
    IL=IL+1
    HCLC(I)=-.45
    I=I+1
791 GO TO 773
    CCNTINUE
C
C
C
C
C
    RANDCMIZE SPECTRUM A STMIN LOADS WITH .11LL(1G.) LCADS
    TO EQUAL NUMBER OF STMAX LOADS
C
    IA=0
    IB=0
    J=1
    I=1
    ITCTAL=0
    IX=4777
780 CALL RANDU(IX,IY,YFL)
    IX=IY
    IF(ITOTAL.EQ.4201) GO TO 792
    IF((YFL.GE.0.).AND.(YFL.LT..2)) GC TO 781
    IF((YFL.GE..2).AND.(YFL.LT.1.)) GC TO 782
781 IF(IA.EQ.101) GO TO 780
    ITCTAL=ITOTAL+1
    IA=IA+1
    RTMIN(J)=HCLD(I)
    I=I+1
    J=J+1
    GC TO 780
782 IF(IB.EQ.4100) GO TO 780
    ITCTAL=ITOTAL+1
    IB=IB+1
    RTMIN(J)=.11
    J=J+1
    GC TO 780
792 CCNTINUE
C
C
C
C
    ESTABLISH A GROUND CYCLE EVERY HOUR ( 42 EVENTS)
C
    CC 795 J=1,4201,42
    RTMIN(J)=-.08
795 CCNTINUE
C
C

```



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